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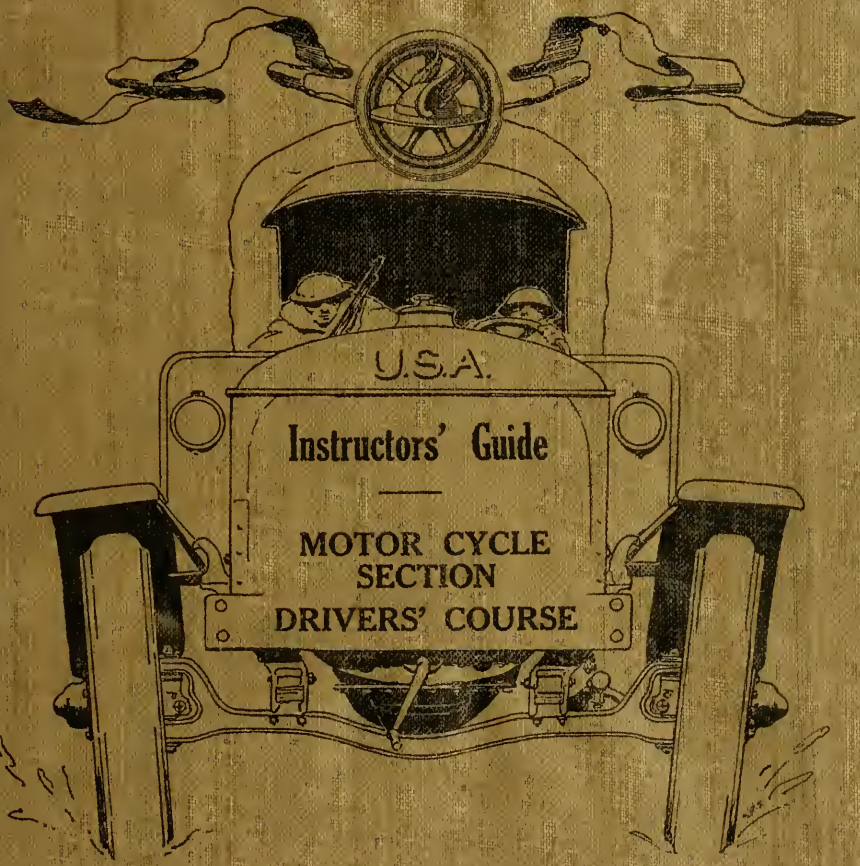
MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION
TRAINING BRANCH



WASHINGTON, D. C.
November—1918

Class UC347

Book .U5

1918

U.S. Motor transport corps

MOTOR CYCLE DRIVERS' COURSE

OF THE

MOTOR TRANSPORT CORPS

M. T. C. Operation
M. T. C. Maintenance
M. T. C. Administration
Laboratory

Shop Work
Cleaning, Oiling,
Inspection
Military Instruction

LENGTH OF COURSE, THREE WEEKS

Form MTC—432

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GENERAL STATEMENT

DIRECTIONS FOR INSTRUCTORS.

Underlying all successful instruction must be the realization on the part of each man called upon to teach in any subject that all instruction is given for the student, not for the instructor. Obviously, then, the success of a teacher must be measured by the amount of his teaching which is converted into working knowledge by his students. The job, then, for every member of the instructing staff at every school is to put his information across so that the members of the class get it and are able to use it.

The results obtained in frequent quizzes, oral test questions, or the performance of duties by the student, which require the application of material taught, are the fundamental measures of the success of the instructor in his work. Too much emphasis should not be placed on set written examinations, for a great deal of information may be acquired and used in a poll parrot manner, allowing a man to get high rating on a written examination, but a very low rating on any examination in which the student must apply the knowledge obtained in class room to the performance of a definite task.

The instructor should also bear in mind that men learn most things through one, or more, of three senses: hearing, sight and touch, and that that instruction will be the most successful which permits the student to learn in the most ways. Furthermore, some men learn best by hearing, others by touch, and still others by sight, so that no one method can be used with maximum success for all.

Having the foregoing facts in mind. every instructor, in preparing his work for class presentation, should plan to use, to the fullest possible extent, in the class, pieces of equipment, such as: rifles, pack equipment, parts of vehicle mechanism, such as axles, carburetors, spark plugs, or even whole chasses, if required, etc., etc. He should also use blackboards as much as possible for sketches, diagrams or definitions, etc., and should, so far as possible, insist that each student keep a note book in each subject, which must be neat in appearance and accurate in their statements. This will necessitate their inspection periodically, which should be done by the instructor or his assistants.

It will be seen that certain lectures are much shorter than would be required to fill the entire periods allotted to them. This is done purposely so that there will be an opportunity for the instructor to make up for lost time, occasioned by inspections, etc., etc.; or an opportunity for quizzes, special lectures, and such other work as the instructor may desire.

It will also be seen in the course for Motor Transport Company Mechanics that in places a four-hour period is devoted to certain lectures. This is done because the company mechanic must be a skilled workman and it is not enough for him to be informed on a subject; he must also be able to perform certain duties. The long lecture period permits reiteration, discussion and repeated demonstration on the part of the instructor, so that the student will get all details and be able to use his information. The instructor should use all his ability to put his ideas across in as many ways as possible to be sure that his class gets them thoroughly.

Instructors must look well to the discipline of their classes. Insistence should be placed on all students sitting in proper attitudes during class, and

no lounging or otherwise careless appearance permitted. When the instructor enters the room, all students should rise and remain standing until ordered to be seated. They should also rise when an officer enters the room and remain standing until otherwise directed. In short, strict military discipline should be insisted upon at all times by the instructor, and he should be especially careful that all his acts are also guided by the same precepts.

General Statement

The lectures in this book are designed for the use of the instructors in the various subjects, and are written from that standpoint, following the curriculum outline in detail.

The material is put in this form for the use of instructors so that training at all schools may be uniform. Copies of this book are not to be used for student's text books, and where any of the material contained in this book is desired for students' use it is expected that it will be reproduced by mimeograph or otherwise.

The lectures are not to be read to the students, but are to give the instructors the subject matter to be covered, as well as the method of presentation.

The material given under Exercises is written in lecture form but is to be covered by informal discussion, or otherwise, as the instructor may feel to be desirable.

Under quizzes and written examinations are given typical questions, not formal examinations as such. It is expected that the instructor will use such of the questions as he may wish for his work, but the main intent in setting down the questions is to give the instructor a standard of values by the aid of which he should be able to make up his own questions as need arises.

It is planned to issue bulletins on training activities once a month, for the use of instructors at all M. T. C. training camps. These bulletins will be sent in quantities to the Commanding Officers of all M. T. C. training camps, for distribution, to the instructing personnel.

It will be well for instructors who are teaching mechanical subjects to secure the Instructor's Guide for Company Mechanics' Course, as there are many details of the vehicle mechanism and diagrams that will be helpful in any work of that character.

No lectures are written on Military Instruction as the plan is to follow the reference books closely and have only informal lectures, recitations and quizzes.

Where lectures are prepared for periods not stated as lecture periods in the curriculum, it is designed that the material covered by the lecture will be given in an informal way during the period assigned for the work.

Some lectures will be found to be longer than others, and some will be found too short to cover the entire period assigned. This arrangement is made purposely to permit leeway to compensate for the personal equations of the various instructors, as well as to allow for hours lost or shortened by various unforeseen circumstances. Where spare time is provided by this means it is to be used in bringing up the work, if behind schedule, or for review or quiz, if the work is on schedule.

Motor Truck Drivers

Instructors will become familiar with the duties of the truck driver and use every effort to impress upon such students just what their duties are and especially what they are not to do. It must be borne in mind that the driver does only the most elementary work on the truck, such as oiling and greasing, tightening loose bolts and nuts, changing spark plugs, filling the radiator, tightening loose wires, draining the carburetor, etc. He makes no actual repairs of any magnitude on the motor, or vehicle, except under the direction of the company mechanic. In view of the foregoing, the instruction should be confined to making the driver familiar with the construction of his vehicle and the relation of its parts, but not technically proficient in anything but the most minor repairs. Time may well be spent in training him to diagnose motor troubles by their symptoms, together with an understanding of their causes, so that he may know just what the trouble is, the seriousness of letting it go unattended, and the probable time required to make the repairs. Training of *truck drivers must* be restricted by the foregoing considerations.

Motor Car and Cycle Drivers

Motor Cars and Cycles operate as independent units, therefore the drivers must be taught not only the general mechanism, etc., of the vehicles, but also the road repairs and adjustments which are commonly made on vehicles by skilled operators. It is often impossible to get a mechanic for this work and the driver must be able to make repairs of such character as will be permanent, so the training of such men in maintenance as well as driving must be of a thorough nature.

Military Courtesies

It is designed that all students should be instructed in military courtesy and all commanding officers and senior instructors should have copies of the pamphlet on "Military Courtesies" published by the Training Branch, M. T. C. and see that all students are instructed in conformity with the directions therein contained.

The fact that an enlisted man completed a course in an M. T. C. School shall be recorded under "Remarks" on his Service Record, stating the course completed, the date and the general average of his work.

M. T. C. Training Publications

The following material may be obtained in quantities as desired by application to the Chief, Training Branch, Motor Transport Corps, Washington, District of Columbia.

A. Report Forms for Use in M. T. C. Courses.

1. Motor Transport Company Officers' Course, Forms M. T. C.-289 and M. T. C.-290.
2. Motor Transport Company Truckmasters' Course, Forms M. T. C.-291 and M. T. C.-292.
3. Motor Truck Drivers' Course, Forms M. T. C.-293 and M. T. C.-294.
4. Motor Car Drivers' Course, Forms M. T. C.-295 and M. T. C.-296.

5. Motor Cycle Company Officers' Course, Forms M. T. C.-297 and M. T. C.-298.
6. Motorcycle Drivers' Course, Forms M. T. C.-299 and M. T. C.-300.
7. Motor Transport Company Mechanics' Course, Forms M. T. C.-301 and M. T. C.-302.

B. Tables of instructionnel personnel for schools of different sizes.

C. Tables of equipment for schools of different sizes.

D. Blank diplomas for awarding to students in officers' courses at the completion of their courses.

E. M. T. C. Curriculum of Field Service Training.

F. Tentative Manual of Training of the Motor Transport Corps.

G. Instructors' Guide for Motor Transport Company Officers' Course.

H. Instructors' Guide for Motor Transport Company Non-Commissioned Officers' Course.

I. Instructors' Guide for Motor Transport Company Drivers' Course.

J. Instructors' Guide for Motor Car Company Drivers' Course.

K. Instructors' Guide for Motor Cycle Company Officers' Course.

L. Instructors' Guide for Motor Cycle Company Drivers' Course.

M. Instructors' Guide for Motor Transport Company Mechanics' Course.

N. Curriculum and Lectures for the M. T. C. Administrative Officers' Course.

O. Course in Military Courtesies.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH.

Motor Cycle Drivers' Course

SCHEDULE OF CLASSES

On the following page will be found, in tabular form, schedules of class hours for two sections of students in the Motor Cycle Drivers' Course, which are based on the requirements of the curriculum. The schedules as laid out are designed to bring about the most efficient utilization of all training facilities as: instructors, equipment and class rooms.

The all-day convoy periods are designed to permit each section to have all the vehicles it requires for such a trip without conflict with the other section.

Should it be desired to increase the number of sections beyond two, it can be most expeditiously done, giving one section the work which is scheduled from 10 to 12 a. m. from 8 to 10 a. m., and then giving it the work scheduled from 8 to 10 a. m. from 10 to 12 a. m. This arrangement has been worked out in the Motor Truck Drivers' Course in detail, and by reference to it, any questions should be cleared without difficulty.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH.

FIELD SERVICE TRAINING

Motor Cycle Drivers' Course

Length: Three Weeks

FIRST SECTION

First Week

Day	6.30-8	8-9	9-10	10-11	11-12	1-2	2-3	3-4	4-5	6.30-10
1	Infantry Drill Exercise I	Laboratory Exercise I		M. T. C. Operation Lecture I	M. T. C. Administration Lecture I	Preliminary Driving Exercise I				
2	Infantry Drill Exercise II	Laboratory Exercise II		M. T. C. Operation Lecture II	M. T. C. Administration Lecture II	Preliminary Driving Exercise II				
3	Infantry Drill Exercise III	Laboratory Exercise III		M. T. C. Maintenance Lecture I	M. T. C. Administration Lecture III	Convoy Exercise I				
4	Infantry Drill Exercise IV	Laboratory Exercise IV		M. T. C. Operation Lecture III	M. T. C. Administration Lecture IV	Convoy Exercise II				
5	Infantry Drill Exercise V	Laboratory Exercise V		M. T. C. Maintenance Lecture II	M. T. C. Administration Quiz	Convoy Exercise III				
6	Infantry Drill Exercise VI	Laboratory Exercise VI		M. T. C. Operation Lecture IV	M. T. C. Administration Lecture V	Cleaning, Oiling and Inspection Exercise I				

Second Week

7	Infantry Drill Exercise VII	Laboratory Exercise VII		M. T. C. Maintenance Quiz	M. T. C. Administration Lecture VI	Convoy Exercise IV				
8	Infantry Drill Exercise VIII	Shop Practice Exercise I		M. T. C. Maintenance Lecture III	M. T. C. Administration Quiz	Convoy Exercise V				
9	Infantry Drill Exercise IX	Laboratory Exercise VIII		M. T. C. Operation Lecture V	M. T. C. Administration Lecture VII	Convoy Exercise VI				
10	Infantry Drill Exercise X	Laboratory Exercise IX		M. T. C. Maintenance Quiz	M. T. C. Administration Lecture VIII	Convoy Exercise VII				
11	Infantry Drill Exercise XI	Laboratory Exercise X		M. T. C. Operation Quiz	M. T. C. Administration Lecture IX	Convoy Exercise VIII				
12	Infantry Drill Exercise XII	Laboratory Quiz		M. T. C. Administration Quiz		Convoy Exercise IX				

Third Week

13	Infantry Drill Exercise XIII	Shop Practice Exercise II				Convoy Exercise X				
14	Infantry Drill Exercise XIV	Shop Practice Exercise III				Convoy Exercise XI				
15	Infantry Drill Exercise XV	Convoy Exercise XII								
16	Infantry Drill Exercise XVI	Shop Practice Exercise IV				Convoy Exercise XIII				
17	Infantry Drill Exercise XVII	Shop Practice Exercise V				Convoy Exercise XIV				
18	Infantry Drill Exercise XVIII	Shop Practice Exercise VI				Cleaning, Oiling and Inspection Exercise II				

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH.

FIELD SERVICE TRAINING

Motor Cycle Drivers' Course

Length: Three Weeks

SECOND SECTION

First Week

Day	6.30-8	8-9	9-10	10-11	11-12	1-2	2-3	3-4	4-5	6.30-10
1	Infantry Drill Exercise I		Preliminary Driving Exercise I			Laboratory Exercise I		M. T. C. Operation Lecture I	M. T. C. Administration Lecture I	
2	Infantry Drill Exercise II		Preliminary Driving Exercise II			Laboratory Exercise II		M. T. C. Operation Lecture II	M. T. C. Administration Lecture II	
3	Infantry Drill Exercise III		Convoy Exercise I			Laboratory Exercise III		M. T. C. Maintenance Lecture I	M. T. C. Administration Lecture III	
4	Infantry Drill Exercise IV		Convoy Exercise II			Laboratory Exercise IV		M. T. C. Operation Lecture III	M. T. C. Administration Lecture IV	
5	Infantry Drill Exercise V		Convoy Exercise III			Laboratory Exercise V		M. T. C. Maintenance Lecture II	M. T. C. Administration Quiz	
6	Infantry Drill Exercise VI		Convoy Exercise IV			Laboratory Exercise VI		M. T. C. Operation Quiz	M. T. C. Administration Lecture V	

Second Week

7	Infantry Drill Exercise VII		Convoy Exercise V			Laboratory Exercise VII		M. T. C. Maintenance Quiz	M. T. C. Administration Lecture VI	
8	Infantry Drill Exercise VIII		Convoy Exercise VI			Shop Practice Exercise I		M. T. C. Maintenance Lecture III	M. T. C. Administration Quiz	
9	Infantry Drill Exercise IX		Cleaning, Oiling and Inspection Exercise I			Laboratory Exercise VIII		M. T. C. Operation Lecture V	M. T. C. Administration Lecture VI	
10	Infantry Drill Exercise X		Convoy Exercise VII			Laboratory Exercise IX		M. T. C. Maintenance Quiz	M. T. C. Administration Lecture VIII	
11	Infantry Drill Exercise XI		Convoy Exercise VIII			Laboratory Exercise X		M. T. C. Operation Quiz	M. T. C. Administration Lecture IX	
12	Infantry Drill Exercise XII		Convoy Exercise IX			Laboratory Quiz		M. T. C. Administration Quiz		

Third Week

13	Infantry Drill Exercise XIII		Convoy Exercise X			Shop Practice Exercise II				
14	Infantry Drill Exercise XIV		Convoy Exercise XI			Shop Practice Exercise III				
15	Infantry Drill Exercise XV		Convoy Exercise XII							
16	Infantry Drill Exercise XVI		Convoy Exercise XIII			Shop Practice Exercise IV				
17	Infantry Drill Exercise XVII		Convoy Exercise XIV			Shop Practice Exercise V				
18	Infantry Drill Exercise XVIII		Cleaning, Oiling and Inspection Exercise II			Shop Practice Exercise VI				

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH.

Motor Cycle Drivers' Course

M. T. C. OPERATION

LECTURE I

ORGANIZATION OF MOTOR TRANSPORT COMPANY.

ORGANIZATION OF MOTORCYCLE COMPANY.

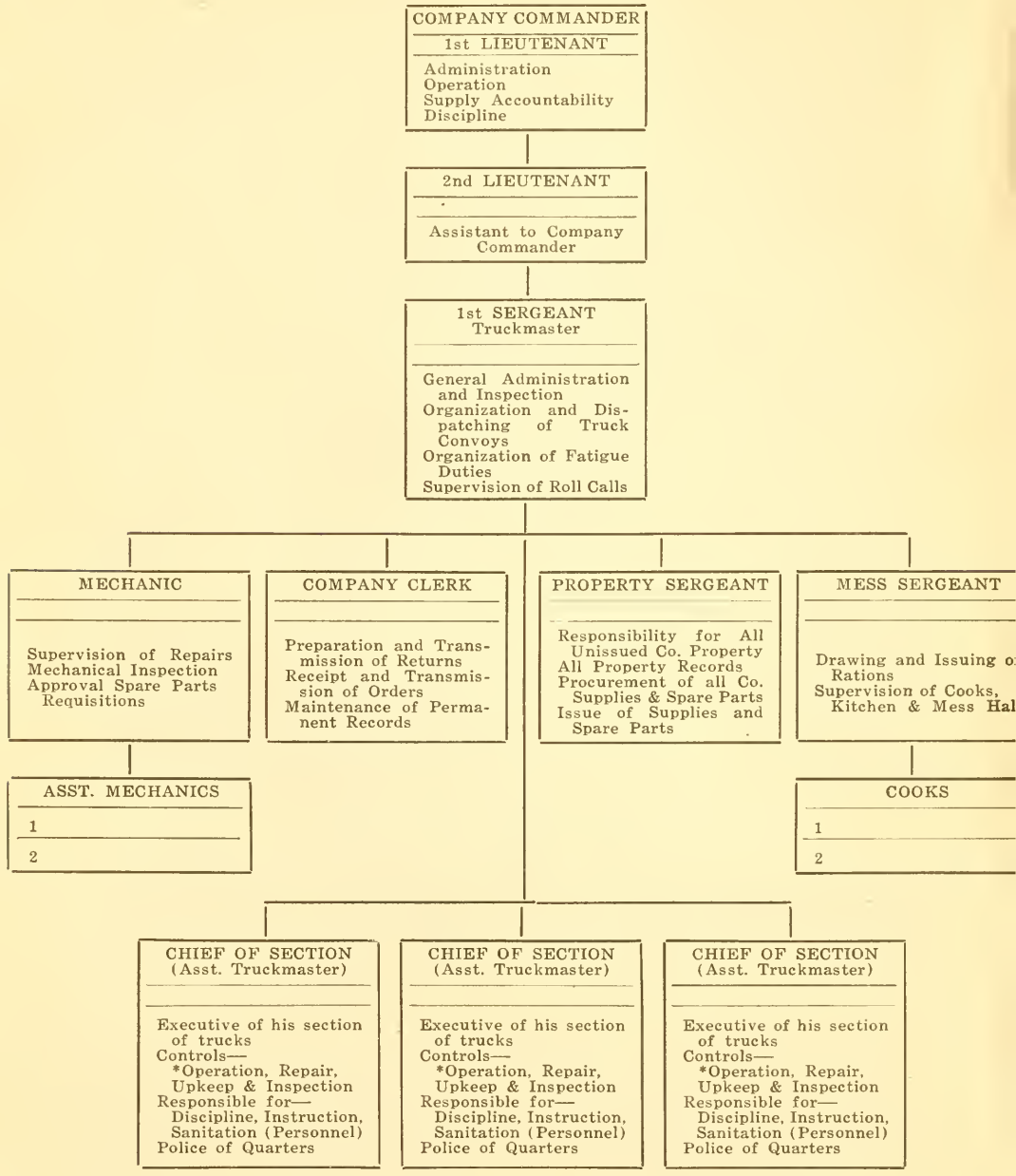
DUTIES AND RESPONSIBILITIES OF PERSONNEL

ORGANIZATION OF MOTOR TRANSPORT COMPANY

UNITS		REMARKS
1st Lieutenant	1	a. Truckmaster.
2nd Lieutenant	1	
Total Commissioned	2	b. 1 Clerk; 3 Chiefs of Sections (assistant truckmasters); 1 Mess Sergant; 1 Property Sergeant; and 1 Mechanic.
1st Sergeant	a1p	
Sergeants	b7-1p6r	c. 2 Assistant Mechanics and 32 Drivers.
Corporals	cr34	
Cooks	2r	d. 9 Assistant Drivers and 1 Messenger.
Privates, 1st Cl.	dr10	
Privates	er24	e. Assistant Driver.
Total Enlisted	78	
Aggregate	80	p. Armed with Pistol.
Cars, Motor, Light		r. Armed with Rifle.
Open (5 Pass.)	1	
Motorcycle with side car	1	v. Class A or Class B.
Trucks, cargo	v27	w. 1 Truck, Light Repair and Truck for Company Supplies (Class AA).
Trucks, cargo	w2	
Trucks, tank	2	NOTE.—If Company is partially or fully equipped with passenger cars instead of trucks substitute two passenger cars for each cargo truck of Class A or Class B.
Kitchens, rolling		
Trailmobile	1	
Pistols	4	
Rifles	76	

NOTE.—Class AA is three-quarter ton truck.
Class A is one and one-half ton truck.
Class B is three ton or over truck.

The following chart shows in graphic form the division of duties and responsibilities in the standard Motor Transport Company.



*Includes Responsibility for Drawing Gasoline, Oil and Grease.

The motor transport company is normally organized into three sections of nine trucks, each section under the command of an assistant truckmaster. The service trucks, i. e., tank trucks, etc., are usually kept under the immediate orders of the truckmaster, as they do not form an integral part of the cargo sections. When the company is not operating in convoy, the service trucks may be assigned to cargo work, and in such cases should be attached to sections.

Duties and Responsibilities of Personnel

Company Commander.—He is responsible for the efficient operation, maintenance, and discipline of his company. He must constantly bear in mind that the value of his organization is measured by the efficiency with which it operates, and by its ability to cope with emergencies.

Second Lieutenant.—This officer is the direct assistant of the company commander, and has such duties and responsibilities as are given him by the company commander.

First Sergeant.—He is the truckmaster and the executive of the company. He sees that all orders, regulations, and other requirements are carried out; that the men perform their duties properly; and reports to the company commander any cases of neglect or violation of orders requiring disciplinary action. He should be a man chosen more for his administrative and executive ability and his efficiency in handling men than for his mechanical knowledge. The mechanic may well be chosen for his ability as a mechanic, irrespective of his ability to handle men, but the first sergeant should be a man of force, as his prime duty is to maintain discipline for the efficient operation of the company.

Mechanic and Assistant Mechanics.—The mechanic and assistant mechanics are under the direct control of the first sergeant. The mechanic should be held responsible that the necessary repairs are made to the mechanical equipment of the company. He is in charge of the repair truck, and tools and equipment pertaining thereto. He should sign for the tool equipment and issue it to the assistant mechanics on proper receipts. He should be held responsible that this equipment is properly maintained and that any shortages by damage, loss, etc., are properly made up. Normally, he should see that the assistant mechanics are properly qualified, and should instruct them in their work. In order to perform their duties properly the mechanic and assistant mechanics should be thoroughly familiar with the instruction books issued by the maker of the vehicles issued to the company.

Company Clerk.—He has charge of all records, reports and correspondence of the company. As he is habitually called on to notify members of the company as to orders and instructions received, or to call upon them for the rendering of prescribed reports, and in consideration of other incidents where he must exercise authority, he has the rank of sergeant. Other duties for him are prescribed by the company commander according to local conditions.

Property Sergeant.—He is responsible for all supplies and equipment not actually issued to individuals, and will keep the necessary records therefor. He is responsible, moreover, that all issues of property are properly receipted for by the persons responsible. He keeps the property under his charge clean and in proper order, and should have a list up to date of all property and its disposition. All dealings with the quartermaster or supply officer, not requiring the personal intervention of the company commander, should be carried on by him.

Mess Sergeant.—He has direct charge of the mess hall, kitchen, and all matters pertaining thereto, including supervision of the cooks and other men

working in the kitchen. He draws the rations, sees that they are economically used, makes up bills of fare, sees that the kitchen, mess hall, and premises are clean and sanitary, and that all orders in reference thereto are properly carried out. His authority to contract debts, or expend money should be carefully watched and checked by the company commander personally. In some cases the duties of mess sergeant are performed by the property sergeant, but this depends on the special aptitude of the man, as well as on other local conditions in the company.

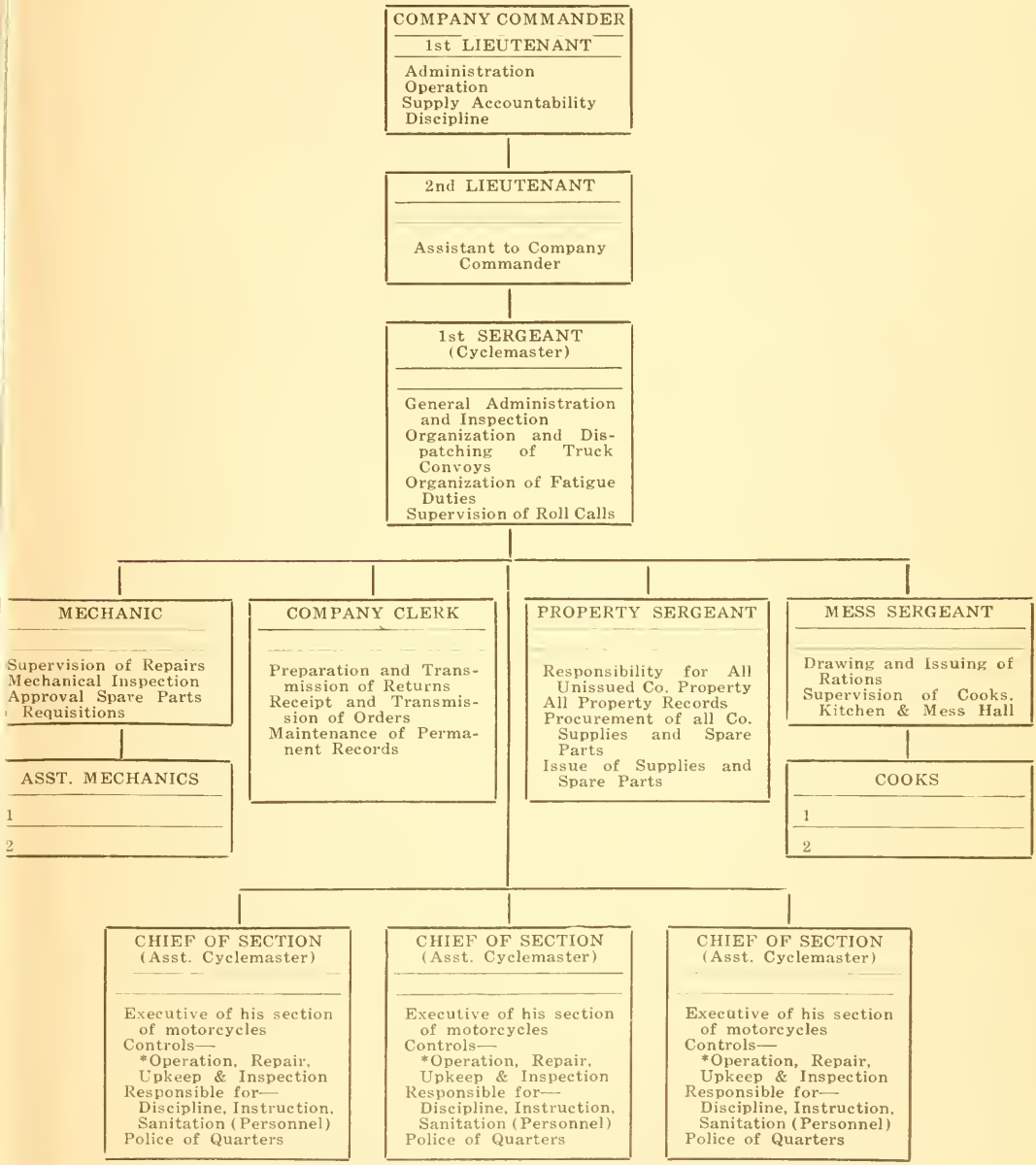
Chiefs of Sections.—Each chief of section (assistant truckmaster) is responsible for the discipline, instruction, and all other matters pertaining to the personnel of his section; for the operation, repair and upkeep of the equipment assigned thereto. He is the intermediary between the men of his section and the truckmaster or company commander. His supervision extends to all the details connected with his section, including police and sanitation of quarters, seeing that his men are provided with the necessary equipment and clothing. All orders for his section, either to the various members of his personnel or to the units of his equipment, should be given to him. He should assure himself that his section is in proper condition at all times by making regular and systematic inspection of his men and equpiment. He should examine all his vehicles on their return from work, and see that the drivers have taken proper care of them and that the proper repairs are made. In his absence, for any cause, a suitable man should be designated to perform his duties.

Driver.—He keeps his vehicle and its equipment clean and in proper repair and working order. In order to do this, he utilizes his spare time while not on duty to do the minor work required thereon. He should be especially required to attend to the proper lubrication of all parts and truck mechanism, and to report promptly any defect noted or repair needed. In transporting material or supplies, he will see that the vehicle is not overloaded, that the cargo is properly loaded and lashed, and ordinarily he is responsible for its safe delivery. He should be familiar with the mechanism of his vehicle and its proper operation, and for this purpose he should be thoroughly familiar with the contents of the instruction book issued by the makers of the vehicle. He should be required to wear proper uniform when driving.

ORGANIZATION OF MOTORCYCLE COMPANY

UNITS		REMARKS
1st Lieutenant	1	a. Cycle-master.
2nd Lieutenant	1	b. 1 Mess and Supply Sergeant; 1 Mechanic and 3 Assistant Cycle-masters.
Total Commissioned	2	c. Clerk.
1st Sergeant	a1p	d. 1 Assistant Mechanic; 2 Drivers and 27 Motorcycle Drivers.
Sergeants	b5p	p. Armed with Pistol.
Corporal	c1p	w. For Company Supplies.
Cook	1p	
Privates 1st Cl.	d30p	
Total Enlisted	38	
Aggregate	40	
Motorcycles with side car	32	
Trucks, Cargo, Class AA	w2	
Pistols	40	
Rifles	....	

The following chart shows in graphic form the division of duties and responsibilities in the standard Motorcycle Company.



*Includes Responsibility for Drawing Gasoline, Oil and Grease.

Duties and Responsibilities of Personnel

General.—The motorcycles and side cars assigned to a company will be one of the various standard makes issued to the army. The details of equipment vary according to the specific make of motorcycle, and there is no general list of equipment that covers all of these types. The specific list, however, will be given in the invoices or other record of property furnished the company commander when he receives motorcycles assigned to his company. In addition to this invoice, he should procure the printed publications issued by the manufacturer of the motorcycle which ordinarily include detailed instructions as to their care, operation and upkeep, and a parts list, giving the serial or manufacturer's number of each part.

In each company, the division of responsibility with reference to operation, repair and upkeep of the mechanical equipment should be established by the company commander, and published in a company order, so that each member of the company shall be thoroughly familiar therewith.

Duties of Assistant Cycle Master.—Each assistant cyclemaster is responsible for the discipline, instruction, and all other matters pertaining to the personnel of his section; and for the operation, repair and upkeep of the equpiment assigned thereto. He is the intermediary between the men of his section and the cyclemaster or company commander. His supervision extends to all details connected with his section, including police and sanitation of quarters, seeing that his men are provided with the necessary equipment, clothing, etc. All orders for his section, either to the various members of his personnel or to the units of his equipment, should be given to him. He should assure himself that his section is in proper condition at all times by making regular and systematic inspections of his men and equipment. He should examine all his motorcycles on their return from work, and see that the drivers have taken proper care of them, and that the proper repairs are made. In his absence, for any cause, an acting chief of section should be designated to perform his duties.

Duties of the Mechanic and Assistant Mechanics.—The practice in reference to mechanics varies in different companies according to local circumstances. The two general systems are (1) the mechanic and assistant mechanics are under the direct control of the cyclemaster and are not assigned to a given section; (2) the mechanic and assistant mechanics are assigned to sections and each come under the control of the corresponding chief of section. In either case, however, the mechanic should be held generally responsible that the repairs are made. He is in charge of the repair and tool equipment pertaining to the organization. He should sign for the tool equipment and issue it to the assistant mechanics on proper receipts. He should be held responsible that this equipment is properly kept up, and that any shortages by damage, loss, etc., are properly made up. Normally, he should see that the assistant mechanics are properly qualified and should instruct them in their work. In order to perform properly their duties, the mechanic and assistant mechanics should be thoroughly familiar with the instruction book issued by the maker of the machines furnished the company.

Duties of Driver.—He keeps his motorcycle and its equipment clean and in proper repair and working order. In order to do this, he utilizes his spare time while not on duty to do the minor work required thereon. He should be especially required to attend to the proper lubrication of all parts of the motorcycle mechanism, and to report promptly any defect noted or repair needed.

Operators are cautioned against overloading a motorcycle or side car. The maximum weight to be carried by a solo motorcycle is 300 pounds. The maximum for a motorcycle and side car combination is 450 pounds. These weights apply to the twin-cylinder, three-speed motorcycles now in use. The driver should be familiar with the mechanism of his machine and its proper operation, and for this purpose he should thoroughly study the contents of the instruction book issued by the maker. The driver should be required to wear the proper uniform when driving.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

M. T. C. OPERATION

LECTURE II

ROAD RULES

Road Rules.—When driving in company or other formation, or single, the following road rules must be observed:

1. When stopping or slowing down, raise either arm to a vertical position from the shoulder, and hold it in this position until a stop is made or reasonable speed is resumed.

2. When turning right, extend the right arm horizontally from the shoulder, and when turning left extend the left arm horizontally from the shoulder, holding the arm in this position until the turn is made.

3. On a crowded road make no attempt to turn unless the turn can be made completely under power.

Order of March.—The order of sections in column should ordinarily alternate daily. The repair car should be in rear of the train. The company commander rides wherever he judges his presence necessary, but it is generally at the rear of the column that he will render his supervision most efficient. The cycle-master rides wherever the company commander directs. The assistant cycle-masters ride with their sections where they can most efficiently conduct their operation. The mechanic rides in the repair car. The assistant mechanics may ride either in side cars, or may be placed in the two forward sections of the company.

Distance Between Vehicles.—Except on very dusty roads or those with heavy grades, where greater distances may be taken, the vehicles should be about ten yards apart. Due to variations in mechanism and skill of drivers different vehicles do not ascend slopes at the same speed. Therefore, these distances will vary, but the leading vehicle should normally slow down after climbing a slope so that the train will not spread out too much. In some cases, after climbing or descending a difficult slope, the leading vehicle should stop to allow the column to close up.

Rate of March.—This depends on the condition of the roads, as well as on other incidents of the march. The leading motorcycle should rarely take the maximum authorized speed, as motorcycles in the rear will have to exceed that in order to keep up. The speed should be as regular as possible, so that motorcycles may keep their distances without speeding. Never allow individual motorcycles to exceed the authorized speed limit.

March Discipline.—Vehicles must always keep well on the right of the road. This is especially necessary in operating on roads in field service. This requirement must be rigidly enforced. The driver of each motorcycle, personally, or by means of a rider in his side car, should keep in touch with the motorcycle in rear, so that if any halt is made, he can do likewise and give the proper signal to the motorcycles in front. Under no circumstances should a company spread out on the road; this should be a constant pre-occupation of all in authority in the company. If a motorcycle stops for repairs, the entire company should stop. The company commander, or the cycle-master if so authorized, should ascertain the time required for the repair and the nature of

same. The company commander will promptly decide whether to halt the company until the repair is completed, to leave the machine with sufficient personnel to make the repair and to rejoin the company later, or to abandon the motorcycle. The company commander, in deciding whether to abandon a machine, must remember that "Service" is the mission of the company, and that it is no disgrace to abandon a motorcycle whose mechanism has broken down. This point of service is one that the company commander should constantly bear in mind as his subordinates are generally more interested in the mechanism of the motorcycle, and more apt to lose sight of the purpose of the company in their interest in repairing the equipment.

Road Difficulties.—These are due to the nature of the road surface, the grades or natural obstacles encountered. In muddy roads it may be necessary to use chains on the traction wheels. Do not let the motorcycle wheel revolve uselessly, as that simply serves to dig it in deeper. In getting motorcycles through sand or mud, the greater part depends on the practical genius of the members of the company. In going up steep grades, or crossing streams, be careful to keep the motorcycles far apart to avoid any possible accident. A similar condition exists with reference to descending steep slopes. Brakes should not be relied on, but the gear should be set in first speed, and the motor used as a brake. Hold a driver pecuniarily responsible for having his motorcycle damaged by collision. When crossing a railroad track at a grade crossing, or at any other dangerous place, station a man during the entire passage of the company to insure the safety of the vehicles. At noon give the men some hot food and a big cup of black coffee if practicable, and they will drive as well in the afternoon as in the forenoon.

Daily Marches.—The normal daily march for a motorcycle company is 150 miles. Do not run after dark unless absolutely necessary. Running at night is difficult, fatiguing and very conducive to accident. When running after dark, in company formation, it is absolutely essential that tail lights be lighted, and should the occasion demand, tail lights can be partly obscurred, or hooded, so as to show directly to the rear only.

Parking and Camping.—This is discussed under "Tactical Formations."

Daily Inspection and Upkeep.—On arrvial at camp or bivouac, drivers will make a thorough inspection of their motorcycles, under supervision of the assistant cycle-masters, and all possible repairs will be made. In case of impossibility of repairing a motorcycle, the company commander decides as to its disposition. If the company arrives late at night in the darkness, it is advisable, conditions so permitting, to make this inspection and repair on the following morning before leaving camp.

Replenishment of Gasoline, Oil, Grease, etc.—As soon as machines get into camp or bivouac, they should be replenished with these supplies. By reason of the danger of fire, the gasoline tanks should be filled by daylight. If this is impracticable, due to late arrival of the company, the company commander decides, according to the special circumstances, whether to put this off until the following morning or to fill in the dark. In the latter case, great precaution should be taken. Electric flashlights should be used. There should always be a sufficient number of fire extinguishers handy and several pails of sand or soft earth to smother any gasoline fire that may start. If lanterns are in the vicinity, they should be hung high up, so that they will not ignite gasoline vapors, which being heavier than air, sink to the ground. The rule to be enforced, unless conditions absolutely prevent, is to have all motorcycles filled with gasoline and oil and ready as soon as possible after reaching camp. Each evening the dispatcher makes out written orders for motorcycles in the various

companies to fill the work details for the next day. There are certain classes of work, such as mail routes, that are permanently assigned to certain motorcycles. Other regular classes of work are done by each company according to roster so as to equalize work. In a similar manner, each motorcycle company takes its turn, by roster, on duty to answer special calls.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

M. T. C. OPERATION

LECTURE III

TACTICAL, ROAD AND PARK FORMATION

Position of "Prepare for Inspection."—Men will stand at attention, driver to left of and one foot from front wheel. The assistant cycle-master is in a position corresponding to the driver but on the opposite side of the right motorcycle of his section. Spare drivers and assistant mechanics are in position corresponding to those of the drivers but on the opposite sides of the machines in which they ride. The cycle-master is in line on the right of the rank. The company commander is one yard in front of his side car. All articles of equipment will be laid out so that the company stencils are plainly visible. Motorcycle company commanders cannot be too careful of the grade of oil used. Never allow a tank to be filled wth automobile oil unless in an emergency when motorcycle oil cannot be obtained. In case auto oil has to be used, frequent use of the hand pump is necessary. Motorcycle oil for summer use should be Mobile B; and in winter, Mobile BB; or during extreme cold weather, Mobile A or oils of like viscosity and flash test. The issuing of gasoline and other supplies is done under the immediate supervision of the man detailed therefor. Precautions to be taken against fire should be given in the form of "Fire Orders" prepared by the company commander. On returning to the company park, the drivers turn in the written order, if one was given, that sent them to work and at the same time complete their daily reports and turn them into the company office. The other routine work is carried on according to circumstances that vary so greatly that more definite description thereof would be without profit.

Tactical Formations.—The tactical formations required of a motorcycle company may be classed generally as formations required for road, park and inspection.

Road Formations.—The normal road formation is in column with ten-yards distance between motorcycles, giving company a road space of 400 yards. This distance may be changed at the discretion of the company commander according to the conditions of the march; however, it should never be less than six yards, and then only for very slow rates of speed. Whenever the company halts, the motorcycles should close up to one yard distance without command.

Park Formations.—The company may be parked either in line, double line, column of sections, or, exceptionally, in column or corral.

Line.—Motorcycles are in line, normally with one yard interval between them. A greater or less interval may be ordered by the company commanding officer according to parking space available.

Double Line.—Motorcycles are formed in two lines, machines facing each other with a distance of one yard between front wheels of opposite machines. A greater distance may be ordered by company commander. This is the preferable parking method for a permanent camp or in places where the space or tactical situation permits. In this formation the machines are easily accessible from all sides for work.

Column of Sections.—Sections are in line, with intervals of one yard between machines, and distances of ten yards between sections. These distances and intervals may be varied at the discretion of the company commander.

Column of Corral.—Column—This method of parking is used only where sufficient lateral space is not available for one of the other formations. This would be the case when the company is in bivouac along a road not permitting a line formation. In this case the distance between machines should be reduced to a minimum not over one yard at the most. Corral—the motorcycles may be parked so as to form a closed corral for defense. This is an exceptional method and very rarely resorted to. Formation for inspection—the formation for inspection will be either in line or in column of sections. Interval between machines two yards. Distance between sections 14 yards.

In districts under the control of the French "Commission Regulatrice Automobile" will be found *routes gardees* (policed roads), which are the important communicating roads between points along the French front.

The guards of these routes wear green and white arm bands. The following rules of the *Route Gardee* will be complied with:

1. All signs and notices posted on the *routes gardees* will be strictly obeyed.

2. All instructions given by these road guards, whether they contradict your own instructions or not, must be complied with.

3. Never pass (i. e., double) any motor driven vehicle that is going in the same direction on a *route gardee.* Passenger cars need not conform to this rule.

4. Never stop on a *route gardee.* If you break down, get your vehicle well to the right of the road; if possible, completely off the road.

5. Increase distances between sections fifty (50 yards), i. e., an open space of fifty (50 yards) must be left immediately behind each disc.

6. Do not turn around on a *route gardee.*

The following translation of road signs should be learned:

Ralentir	Slow up.
Passage a Niveau	Railroad grade crossing.
Tenez Votre Droit	Keep to your right.
Tourant Brusque	Sharp turn ahead.
Croisement	Cross roads.
Virage	Sharp turn ahead.
Cassis	Bad bump ahead.
Sens Obligatoire	Must go in direction indicated.
Sens Unique	One way only.
Defense de Doubler	Do not pass any vehicle going the same direction.
Convois Double Circulation	Convoys may use road in both directions.
Vitesse Maxima	Maximum speed.
Defense de Stationner	Prohibited to remain stationary.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

M. T. C. OPERATION

LECTURE IV

OPERATION AND DUTIES

Operation and Duties.—The motorcycles and side cars assigned to a company will be one of the various standard makes issued to the army. The details of equipment vary according to the specific make of motorcycle, and there is no general list of equipment that covers all of these types. The specific list, however, will be given in the invoices of other record of property furnished the company commander when he receives the motorcycle assigned to his company. In addition to this invoice, he should procure the printed publications issued by the manufacturer of the motorcycle which ordinarily include detailed instructions as to their care, operation and upkeep, and a parts list, giving the serial or manufacturer's number of each part.

In each company, the division of responsibility with reference to operation, repair and upkeep of the mechanical equipment should be established by the company commander, and published in a company order, so that each member of the company shall be thoroughly familiar therewith. The general practice is to make each motorcycle driver responsible for the operation, care and upkeep of the motorcycle and equipment, as well as all other property assigned him. The extent of the repairs that the drivers should be required to make depends much upon their ability and training. In general, however, this will extend to what are classed as minor repairs, not requiring a more extensive mechanical knowledge than is possessed by the ordinary driver. Work on the motor, ignition and electric lighting system, or on the interior mechanism of running parts should normally be done under the direct supervision and orders of the mechanic. Aside from this it is better for the chief of section to determine the proficiency of the individual driver before permitting any repair, except the most simple. Beware of the work of amateur experts. The motorcycles of each section are under the direct supervision of the assistant cycle-master (chief of the section), who is held responsible for their upkeep and repairs. Likewise, the mechanic, with the assistant mechanics, has general supervision of the mechanism of the motorcycle equipment, as well as the detailed repair work developing on them.

Duties of Assistant Cycle Master.—Each assistant cycle-master is responsible for the discipline, instruction, and all other matters pertaining to the personnel of his section; and for the operation, repair and upkeep of the equipment assigned thereto. He is the intermediary between the men of his section and the cycle-master or company commander. His supervision extends to all details connected with his section, including police and sanitation of members of his personnel or to the units of his equipment, and all orders affecting the personnel or equipment in his section should be given to him. He should assure himself that his section is in proper condition at all times by making regular and systematic inspections of his men and equipment. He should examine all his motorcycles on their return from work, and see that the drivers have taken proper care of them, and that the proper repairs are made. In his absence, for any cause, an acting chief of section should be designated to perform his duties.

Duties of the Mechanic and Assistant Mechanics.—The practice in reference to mechanics varies in different companies according to local circumstances. The two general systems are (1) the mechanic and assistant mechanics are under the direct control of the cycle-master and are not assigned to a given section; (2) the mechanic and assistant mechanics are assigned to sections and each come under the control of the corresponding chief of section. In either case, however, the mechanic should be held generally responsible that proper repairs are made. He is in charge of the repair and tool equipment pertaining to the organization. He should sign for the tool equipment and issue it to the assistant mechanics on proper receipts. He should be held responsible that this equipment is properly kept up, and that any shortages by damage, loss, etc., are properly made up. Normally, he should see that the assistant mechanics are properly qualified and should instruct them in their work. In order to perform properly their duties, the mechanic and assistant mechanics should be thoroughly familiar with the instruction book issued by the maker of the machines furnished the company.

Duties of Driver.—He keeps his motorcycle and its equipment clean and in proper repair and working order. In order to do this, he utilizes his spare time while not on duty to do the minor work required thereon. He should be especially required to attend to the proper lubrication of all parts of the mechanism, and to report properly any defect noted or repair needed. Operators are cautioned against overloading a motorcycle or side car. The maximum for a motorcycle and side car combination is 450 pounds. These weights apply to the twin-cylinder, three-speed motorcycles now in use. The driver should be familiar with the mechanism of his machine and its proper operation, and for this purpose he should thoroughly study the contents of the instruction book issued by the maker. The driver should be required to wear the proper uniform when driving.

Routine.—The following is a brief account of the daily routine of a company engaged in work at a depot or permanent camp. Any variation will be noted under "Road and Route Marching." The regular reveille and breakfast should be had at the hours prescribed for the command in general. After reveille, the tents or quarters should be properly arranged, bunks made up, etc. The drivers for duty proceed to the park and see that their machines are in proper condition. This is done under the direction of the assistant cycle-masters. The machines are sent out at the proper time for work details.

When a machine returns to the company park, after the day's run, it should be gone over by the driver, under supervision of the assistant cycle-master, and be put in shape for immediate work. This includes the filling of gasoline tanks, replenishment of lubricating material, filling lamps, if they use oil, and in making all repairs and adjustments. The invariable rule should be that motorcycles in park are always ready to make a day's run.

The issuing of gasoline and other supplies is done under the immediate supervision of the man detailed therefor. Precautions to be taken against fire should be given in the form of "Fire Orders" prepared by the company commander.

On returning to the company park, the drivers turn in the written order, if one was given, that sent them to work and at the same time complete their daily reports and turn them into the company office.

The other routine work is carried on according to circumstances that vary so greatly that more definite description thereof would be without profit.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

M. T. C. OPERATION

LECTURE V

NUMBERING AND MARKING OF MOTOR VEHICLES

Form M. T. S. 124 gives instructions to chauffeurs as to their procedure in case of injury caused by their vehicles to persons, animals, or property, and serves as their written report of the accident.

Where and by Whom Used.—Organization commanders will cause each motor vehicle to be supplied at all times with this form. In case of accident the form will be filled in and signed by the chauffeur, and turned in to officer commanding the organization.

System.—In case of any accident, however trivial, which results in injury to person or property, chauffeurs will fill in the information called for on the form and will deliver it to their commanding officers, who will certify in writing, on the form, the day and hour of delivery of report. Commanding officers will in every case institute court-martial proceedings against drivers who fail to render such report immediately upon return to organization. (See G. O. 11, Par. 3 H., A. E. F., 1918.)

Instructions Relative to the Classification, Numbering and Marking of Motor Vehicles

System of Classification.—All motor vehicles will be classified according to type as follows:

Passenger cars (regardless of size or body)	Type	1
Light delivery trucks (1 ton or less)	"	2
One and one-half and two-ton trucks	"	3
Three and four-ton trucks	"	4
Five-ton trucks, or over	"	5
Motorcycles (with or without side cars)	"	6
Motor Ambulances (all sizes and makes)	"	7
Tractors (except Caterpillars)	"	8
Caterpillars	"	9
Trailers (cargo)	"	0
Machine Shop Trucks (regardless of repair equipment)	"	00
Kitchen trailers	"	10
Omnibus cars	"	20
Balloon winch trucks	"	30
Service cars (light repair)	"	40
Disinfectors and fire engines	"	50
Laboratories (dental trucks, medical laboratories, photo laboratories, sterilizing trucks, etc.)	"	60
Machine shop trailers	"	70

Privately owned motor vehicles, such as Y. M. C. A., Salvation Army, etc., authorized to procure oil, gas and repairs from official sources, will be given numbers according to the above classification, and in addition the letter X, following the number.

System of Marking.—All motor vehicles will be painted with O. D. paint prepared according to Government Formula contained in paragraph 3964, page 598, Q. M. 1917 Manual. All letters and numbers on motor vehicles will be stenciled with white paint.

Numbers preceded by "U. S." shall be stenciled on both sides and rear of each motor vehicle in symbols 4 inches high, excepting trailers and motorcycles.

For trailers, numbers preceded by U. S. shall be stenciled in symbols minimum of 1 inch on both sides and rear end of body.

For motorcycles with side cars, numbers preceded by U. S. shall be stenciled in symbols minimum of 1½ inches high on left side of gas tank, rear right side, and front side car.

For motorcycles without side car, numbers preceded by U. S. shall be stenciled in symbols minimum of 1½ inches high, on both sides of gas tank, and on a plate firmly attached to rear mud guard.

System of Numbering.—The first numeral will indicate the type. The succeeding numerals will indicate the number of the machine of that type in service in France. (Type 1, machine No. 685, would be U. S. No. 1685.)

Examples—

Machine No. 1, Passenger car, will be.....U. S. No. 11
Machine No. 1, Light delivery truck will be.....U. S. No. 21
Machine No. 1, One and one-half-ton truck will be.....U. S. No. 31
Machine No. 5. Private passenger car will be.....U. S. No. 15X
Machine No. 6, Private 1½-ton truck will be.....U. S. No. 36X

Additional Marking for Motor Vehicles.—In addition to the above, each motor truck shall have the manufacturer's serial number and the motor number stenciled on each side member of the frame of the chassis in a plainly visible location with symbols one inch high, as follows:

S.....
M.....

Each motor truck cover will bear the same U. S. number as the truck to which it belongs. This number will be stenciled in symbols 4 inches high, so as to be plainly visible from the side.

Headquarters will be indicated by a metal marker 6 inches by 9 inches hung on the wind-shield on the right side of the car.

Rank of general officers will be indicated by a metal marker 6 inches by 9 inches hung on the wind-shield on the left side of the car.

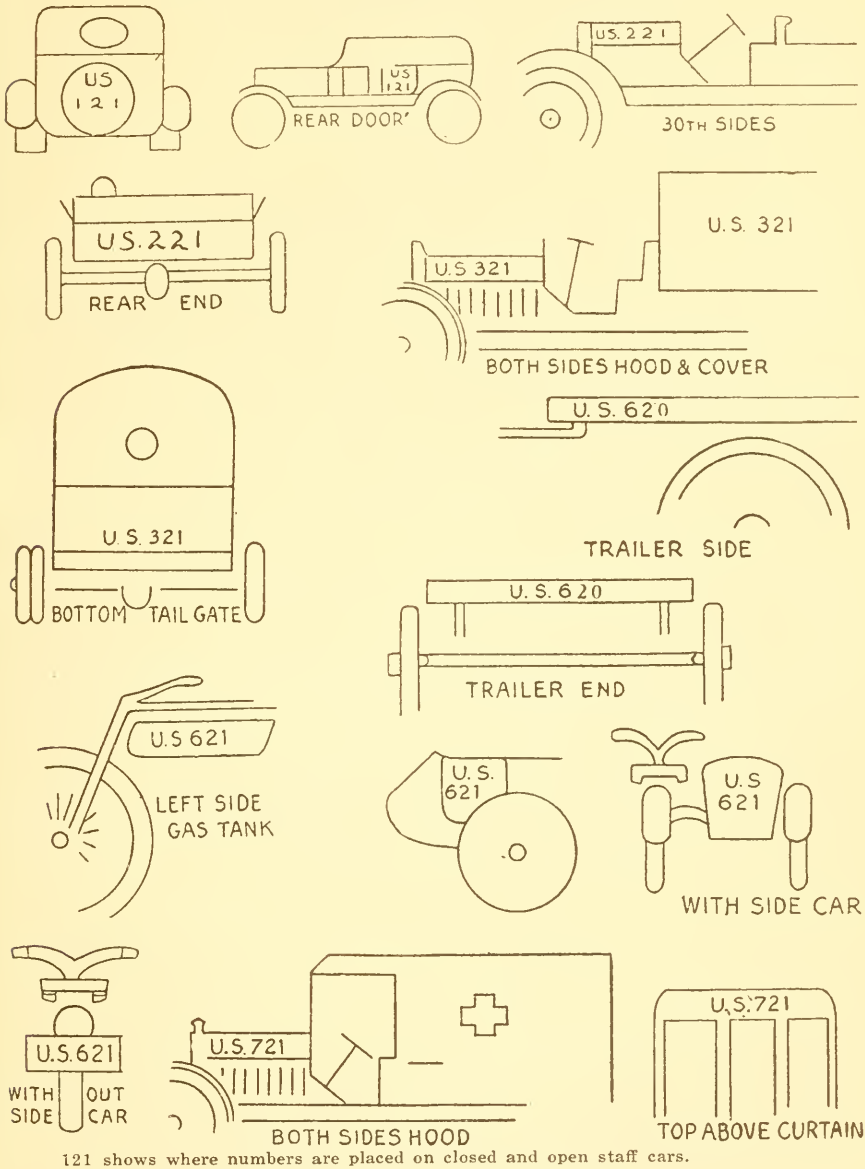
These indications will also be displayed on markers of the same size on the rear of the car, in such a position as to be illuminated by the tail light.

The cars of the different headquarters will be marked by enameled car markers as follows:

The car of the Commander-in-Chief, the American Flag.
The cars of staff officers, headquarters, A. E. F., red, white and blue.
The cars of an Army Commander and Staff, red and white.
The cars of a Corps Commander and Staff, white and blue.
The cars of a Division Commander and Staff, red.
The cars of a Brigade Commander and Staff, blue.
The cars of the Commanding General, Service of Supplies and Staff, white.
All mixed colors will be divided horizontally.
No flags of any kind will be flown from motor cars.

The following diagrams and key will illustrate clearly the method used in numbering the vehicles used by the A. E. F. in France.

MANNER OF MARKING M. T. C. VEHICLES



121 shows where numbers are placed on closed and open staff cars.
221 shows where numbers are placed on open body trucks.
321 shows where numbers are placed on cargo trucks, with cover.
621 shows where numbers are placed on motorcycles, with and without side car
620 shows where numbers are placed on truck trailers.
721 shows the position of numbers on Medical Corps trucks.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

MAINTENANCE

LECTURE I

DRIVERS' DAILY ROUTINE, INSPECTION AFTER RUN, ISSUING OF GASOLINE AND SUPPLIES

The regular reveille and breakfast should be had at the hours prescribed for the command in general. After reveille, the tents or quarters should be properly arranged, bunks made up, etc. The drivers for duty then proceed to the park and see that their machines are in proper condition. This is done under the direction of the assistant cycle-masters. The machines are sent out at the proper time for work details. When a machine returns to the company park after the day's run, it should be gone over by the driver, under supervision of the assistant cycle-master, and put in shape for immediate work, if ordered out. This includes the filling of gasoline tanks, replenishment of lubricating material; filling lamps if they use oil; and in making all repairs and adjustments. The invariable rule should be that motorcycles in park are always ready to make a day's run. Motorcycle company commanders cannot be too careful of the grade of oil used. Never allow a tank to be filled with automobile oil unless in an emergency when motorcycle oil cannot be obtained. In case auto oil has to be used, frequent use of the hand pumps is necessary. Motorcycle oil for summer use should be Mobile B; and in winter, Mobile BB; or during extreme cold weather, Mobile A or oils of like viscosity and flash test. The issuing of gasoline and other supplies is done under the immediate supervision of the man detailed therefor. Precautions to be taken against fire should be given in the form of "Fire Orders" prepared by the company commander. On return to the company park, the drivers turn in the written order, (if one was given) that sent them to work and at the same time complete their daily reports and turn them into the company office.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

MAINTENANCE

LECTURE II

REPAIRS

(*a*) Repairs Made by the Company Mechanic in Relation to Service Parks

(*b*) When Repairs Are To Be Made By Service Park Repairmen

a. On arrival at camp or bivouac, drivers will make a thorough inspection of their motorcycles, under supervision of the assistant cycle-masters, and all possible repairs will be made. In case of impossibility of repairing a motorcycle, the company commander decides as to its disposition. If the company arrives late at night in the darkness, it is advisable, conditions so permitting, to make this inspection and repair on the following morning before leaving camp.

b. As far as possible actual repairs should be made by the two assistant mechanics, leaving the chief mechanic free for supervision of repairs and for inspections.

A log book is supplied for each motorcycle. It must remain with the motorcycle at all times, and drivers will be disciplined if it is lost. In it is entered a record of all repairs of any consequence made on the motorcycle, or the side car if one is attached.

Informal inspections by the company commander should be going on constantly; also by the cycle-master, assistant cycle-masters (who should be held particularly responsible for the upkeep of motorcycles in their sections), and the mechanics. The officer or non-commissioned officer inspecting cannot be expected to make a complete overhauling at every inspection, but by looking in unexpected places where oil cups are located, many cases of laxity will be uncovered. Any dealings with drivers, as the result of inspections, should go through the proper channels.

Formal inspections should be made periodically and under definite rules of procedure as prescribed. The appearance and neatness of the motorcycle and side car, if one is attached, should not be neglected.

Each motorcycle company will be assigned by the Motor Transport Officer of the division, or other unit served by the company, to a definite service park. For all repairs which would consume more than one working day in the company's shop, the disabled vehicle must be sent to the assigned service park.

In case a motorcycle must be sent to a service park for repair, if possible the service park will substitute another motorcycle in its place, on M. T. C. Memorandum Receipt, and the vehicle turned in will be held on a M. T. C. Memorandum Receipt (Form M. T. C. 101).

Companies will be outfitted with spare parts, M. T. C. supplies, and material whenever possible according to standard lists, which are prepared by the

Maintenance Division, Headquarters M. T. C. One copy of these lists should be kept by the company commander and one by the property sergeant. Requisitions for parts, supplies, and material shall be made out on Q. M. C. Form 160, by the property sergeant on the mechanic's recommendation, and signed by the company commander. These requisitions will be forwarded as often as desirable to service park to which the company is assigned. Stock on hand, plus unfilled requisitions should equal the standard lists and should form the basis of inventory.

When any part shows undue wear or breaks, or any trouble or suspected trouble develops beyond the facilities at hand, the part must be replaced, or motorcycle must be sent immediately to the assigned service park for replacement or repair.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

MAINTENANCE

LECTURE III

The following rules are for the guidance of riders as well as for officers and non-commissioned officers. They represent the minimum of attention which must be given to vehicle maintenance, and if a side car is used the body and wheel should be kept free from mud, and the inside of the car body should be cleaned out.

(*a*) *General.*—Care must be given to appearance, as well as to mechanical perfection. See that motor is kept clean. The frame, springs, tanks, motor and wheels should be cleaned whenever possible. If a side car is used the body and wheel should be kept free from mud and the inside of the car body should be cleaned out.

(*b*) Be on the lookout at all times for all leaks, and for unusual noises; find the cause immediately, and remedy.

(*c*) In injecting oil in oil holes be sure that the oil finds its way to the bearings.

(*d*) Never cut out the muffler.

AFTER EACH RUN (*To be done as soon as motorcycle returns from run*) :

(*a*) Fill gasoline and oil tanks. Mobile "B" (in winter "BB" oil), or an oil of equal fire test and body, must be used for motor lubrication. Under no condition should 600-W in any form be used in motors.

(*b*) Fill the oil lamps and examine the tubing from the prestolite tank to the headlights for leaks. See that the prestolite tank contains enough gas for a night's run.

(*c*) Remove mud and dirt from places in immediate proximity to moving parts, such as wheel hubs, hinge pins, bell crank pins and springs. If a side car is attached, remove all mud from the side car wheel.

(*d*) After removing dirt go over the machine and thoroughly oil spring pins, bell crank pins, rear frame hinge pins and handle bar control mechanism.

(*e*) Examine machine for and tighten all loose nuts, screws, etc. Adjust, oil and tighten chains.

(*f*) If a side car is used, and if the machine has been used in mud, the side car wheel bearings will be cleaned and repacked with a good grade of cup grease. This will prevent the wheel cone trouble which is so prevalent at the present time.

(*g*) Wash entire machine if possible.

AT END OF 250 MILES:

(*a*) Clean entire machine thoroughly.

(*b*) Clean spark plugs, oil magneto (only a drop or two), clean carburetor (under supervision of the mechanic).

(*c*) Examine clutch; permit no oil to accumulate on friction surfaces.

(*d*) Fill the transmission case to required level with 600-W oil.

(*e*) Examine and regulate tension of brakes.

(*f*) See that valve tappets are properly adjusted.

(g) Remove, clean and repack side car wheel bearings.

(*h*) Examine all wiring as to insulation and connection.

(*i*) Go over all nuts and bolts, care being taken not to strip threads.

(*j*) Drain the crank case, flush with kerosene and fill with fresh oil. Be sure to replace drain plug after this operation, and inject fresh oil into the crank case by use of a hand pump. Three or four cupfuls will suffice.

(*k*) Remove chains, bathe in kerosene, and thoroughly clean with a brush. After this operation the chains should be slushed with heavy oil before being replaced. Keep the chains properly adjusted at all times.

(*l*) Test the mechanical oil pump for oil leaks.

(*m*) On Indian motorcycles see that the rear fork hinge pin is working properly and is lubricated; also the spring pins.

SUMMARY OF ENGINE TROUBLES AND THEIR CAUSES.

Engine Fails to Start

1. Gas mixture too lean.
2. Water in gasoline.
3. Carburetor auxiliary air valve open.
4. Gasoline supply shut off.
5. Carburetor frozen.
6. Carburetor flooded.
7. Water frozen in gasoline tank or feed pipes.
8. Magneto points improperly adjusted.

Engine Irregular and Lacks Power

1. Poor compression. Leaky valves, worn or broken piston rings.
2. Gas mixture too rich or too lean.
3. Spark plugs dirty.
4. Air leak in intake manifold.
5. Weak intake or exhaust valve spring.
6. Improper clearance between valve stems and push rod.
7. Gap between spark plug points improperly adjusted or porcelain broken.
8. Magneto lead wires short circuited by insulation being broken through by coming into contact with motor.
9. Motor overheated.
10. Retarded spark.
11. Magneto breaker points improperly adjusted.

Engine Stops

1. Gasoline tank empty or shut off valve closed.
2. Water in gasoline.
3. Flooded carburetor.
4. Dirt in carburetor or feed pipe.
5. Magneto wires loose.

6. Gas mixture too lean.
7. Motor "Frozen" from lack of oil.

Engine Overheats

1. Lack of oil.
2. Carbon deposit in combustion chamber.
3. Spark retarded.
4. Gas mixture too rich.
5. Allowing motor to run while standing still.

Engine Knocks

1. Carbon deposit on piston heads.
2. Loose connecting rod bearings.
3. Engine overheated.
4. Loose crank shaft bearings or worn crank shaft.
5. Worn piston cross head pins.
6. Worn Pitman rod upper bushings.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

ADMINISTRATION

LECTURE I

THE SOLDIER

It is the purpose of these lectures to give those soldiers who are chosen to do the different kinds of work in the Motor Transport Corps such information and actual practice as is necessary for the efficient performance of their respective duties.

The training includes a technical course, a general course, drill and actual practice in the particular work assigned.

The course which follows contains such information as will give the student a general knowledge of the army and will help him to understand the particular part which he is to take in this world struggle for liberty.

The modern soldier is a specialist. The science of war has undergone many changes since the days when man went out with spears and armor made of hides and fought with other men in hand to hand combat. The introduction of gun powder with the consequent development of rifles that shoot 750 bullets in a minute and the cannons that shoot many miles with deadly accuracy and the development of transportation facilities, as applied to information, supplies and troops, has made it possible to place vast numbers of soldiers in the field of battle far removed from their home country.

The task of getting them there and maintaining them after they get there, falls upon the nation as a whole and involves the civilians as well as the soldiers themselves.

This mammoth enterprise requires a high degree of organization and specialization. The modern soldier must therefore be a specialist. He must learn his particular task and co-operate with all the others to produce the smoothly operating machine which wins battles and brings victory.

A good soldier, a soldier who serves his country and gains advancement and honor for himself, must have certain qualities.

The first attribute of a good soldier is obedience. "All persons in the military service are required to obey strictly and to execute promptly the lawful orders of their superiors"—A. R. 1. Obedience is the cornerstone of discipline, and it takes discipline to win battles. Prompt, cheerful and efficient obedience helps to bring victory to the army and promotion to the soldier. Disobedience brings defeat to the army and disgrace to the soldier.

He must develop a soldierly bearing. He must walk with his body held erectly, his head up, and take a military pace. His clothes will be clean, well pressed, and in good repair and strictly regulation. His shoes will be shined and his hair neatly trimmed.

He must observe the rules of military courtesy. "Courtesy among military men is indispensible to discipline." It takes many forms and should be practiced at all times. It marks a man as a good soldier among his comrades and particularly among his superiors more quickly than any other one thing.

The salute is one of the marks of courtesy which must be shown by every soldier to his superiors not only in the United States Army and Navy but in the Army and Navy of every other country. When unarmed it is given with the right hand—the right hand is raised smartly to the brim of the hat; fingers together, palm to the left, the forearm at an angle of forty-five degrees, eyes looking directly into the eyes of the person saluted, and is held until the salute is returned or the person has passed. When outdoors and armed with the rifle, the salute will be given by bringing the piece to the right shoulder and the left hand smartly to the small of the stock, palm down; a soldier on sentry or guard duty, armed with a rifle, salutes by coming to "Present Arms." Care should be taken to make the salute in a military manner.

The salute serves two purposes. It is a mark of courtesy among military men and serves as a recognition of the authority which the superior represents. "Day or night, covered or uncovered, whether either or both are in uniform or civilian clothes, salutes shall be exchanged between officers and enlisted men not in a military formation or at drill, work, games or mess, on every occasion of their meeting, passing near or being addressed, the junior in rank or the enlisted man saluting first."

Indoors when not at work, enlisted men rise, uncover, and stand at attention when an officer enters the room, and remain at attention until the officer leaves the room or directs otherwise. If the officer approaches to speak the enlisted man salutes before and after the conversation.

An enlisted man who desires to speak to an officer obtains the authority to do so from the proper person, approaches the officer, stands at attention and salutes. After being recognized by the officer, he states his business briefly and courteously, speaking in the third person. For example, "Sir, Private John Smith desires a transfer." Upon the conclusion of the interview, he will salute, execute About Face and leave.

After saluting an officer once the salute need not be repeated if the officer remains in the vicinity. When an officer approaches a number of enlisted men in the open, the first to see him will call "Attention." They will all stand at attention and salute.

When at work, an enlisted man does not salute unless spoken to.

When in formation an enlisted man comes to attention when spoken to by an officer, but does not salute.

When passing within thirty paces of an officer on foot, or when either or both are riding, an enlisted man will salute. The proper saluting distance is at six paces providing they approach that close. If not the salute will be given at the nearest point of approach.

The fourth attribute of a good soldier is to be a good teamworker. No matter how efficiently he may be individually, unless he co-operates with those about him he will fall short of the mark.

He must have courage. Courage to undergo the dangers of battle; courage to do his duty well day by day; courage to withstand the temptations that will cut down his value as a soldier and as a man.

He must be cheerful. A cheerful man in a squad does better work, receives quicker advancement and is a better leader than a "grouch." So for his own sake and for the sake of those about him he must be cheerful.

He must have confidence in himself. Unless a man has confidence in himself he can't expect others to have confidence in him. This confidence should

be based upon the knowledge of his ability, and ability in the army is determined by the following five things:

First, CHARACTER. Character is determined by observing a man's personal habits, his dependability, his loyalty, his industry and his consideration of subordinates.

Second, INTELLIGENCE. Intelligence is rated according to a man's ability to learn, his previous education, his accuracy and adaptability.

Third, GENERAL VALUE TO THE SERVICE. Professional knowledge, skill, experience, and success as an organizer and administrator are considered.

Fourth, LEADERSHIP. Leadership depends on a man's force, self reliance, initiative, decisiveness, tact and ability to command the obedience and co-operation of men.

Fifth, PHYSICAL QUALITIES. The matter of physical fitness is a most vital one to the soldier. Success in civil life requires good health. It is even more necessary in the army because of the greater strain placed on a man. It is only the man who is physically fit in every sense of the word that can be under fire for months at a time and come out without his nerves being shattered, or drive his truck through all kinds of weather, long hours each day for weeks at a time, or stand the long marches and the many other tasks required of him in the field.

This sort of fitness is only possible to the men who observe the rules of hygiene and sanitation as laid down for them by the medical department. The soldier who becomes diseased due to his failure to observe these laws is worse than a "slacker." The "slacker" only deprives the government of his services. The sick soldier not only gives no service but takes the time and attention of others, and uses the equipment so badly needed for others who are sick through no fault of their own.

All diseases are caused by taking disease germs into the body in greater quantities than can be overcome by the parts attacked. There are five ways that disease germs may be taken into the body:

1. By swallowing them.
2. By breathing them.
3. By touching them.
4. By the sting of insects.
5. By inheritance.

The more common diseases obtained by swallowing germs are: Typhoid fever, dysentery, cholera and ptomaine poisoning. These diseases can be avoided by:

1. Being innoculated.

2. Eating only pure food. Careful inspections of the manufacture, distribution methods and mess halls insure pure food for the soldier providing he keeps his mess kit and hands clean. Always wash the hands and clean the finger nails before meals. Any food obtained at stores should be carefully cleaned before eating. Food must be protected from flies. The mouth should be washed thoroughly each day and decayed teeth repaired.

3. Drinking pure water. Do not use public drinking cups. Never drink water from strange wells, while on the march. Carry a supply of pure water along in the canteen provided.

The more common diseases obtained by breathing in the germs are: Colds, diphtheria, tonsilitis, grippe, scarlet fever, pneumonia and consumption. To avoid these diseases:

1. Cough or sneeze in a handkerchief.
2. Never spit on the floor.
3. Demand fresh air in sleeping quarters.
4. Dampen the floor before sweeping.
5. Brush the teeth daily.

The more common diseases caught by touching the germs are: Itch, sore eyes, boils, lockjaw, small pox and venereal diseases. To avoid these diseases:

1. Be vaccinated.
2. Use only your own toilet articles.
3. Use only your own pipe.
4. Wash your own clothes, in clean water.
5. Avoid diseased persons.
6. Treat all wounds promptly and keep them clean.
7. Stay entirely away from prostitutes.

The more common diseases caught from the sting of insects are malaria, yellow and dengue fever. To avoid these diseases protect yourself from mosquitoes by bed nets, hat nets and by exterminating the mosquitoes themselves.

However, the most careful soldier cannot altogether avoid taking disease germs into his system. So he must keep himself in such good physical condition that his body will throw off these germs and avoid the disease. To do this the soldier must follow the rules of right living. They are as follows:

1. Cleanliness.
2. Plenty of exercise.
3. Plenty of sleep.
4. To keep the excretory organs operating properly.
5. Temperance in eating and drinking.
6. A clean mind.

Hatred, jealousy, envy and licentiousness have fatal results on one's physical condition.

The soldier who cultivates the above attributes is a good soldier and to him success and honor will surely come.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

ADMINISTRATION

LECTURE II

MILITARY CORRESPONDENCE

CLASSES OF MILITARY CORRESPONDENCE
PARTS OF A LETTER
GENERAL RULES
MILITARY CHANNELS
INDORSEMENTS AND ENCLOSURES
CONFIDENTIAL CORRESPONDENCE
PENALTY ENVELOPES
TELEGRAMS

AIM: To give briefly the prescribed methods of handling military communications.

Correspondence

For convenience, correspondence is usually divided into two classes: general and special.

General correspondence is that which arises from routine operations and consists of notifications of orders, regulations, transmission of periodical reports, maps, etc. Because of its wide circulation, general correspondence is ordinarily printed in pamphlet form.

Special correspondence is that between individuals or between departments and individuals.

Parts of a Letter

Whatever may be the nature of Army Correspondence its form is always the same. A military letter is divided into three parts: the brief, the body and the signature. (M. Q. M. C. 323.)

The brief is so called because it gives a synopsis of the letter by means of which it can readily be filed and referred to. It includes the heading, number of letter, the name of the sender and the person to whom sent. Beginning at the top of the paper in the upper right hand corner is the place it is written and the date. In the upper left hand corner appears the number of the letter. This number is for reference and identification purposes. A short space below and about one and a quarter inches from the left edge of the paper is the word "From" followed by the official designation of the writer or if that is lacking the name, rank and regiment, corps or department. Immediately below is the word "To" followed by the official designation or the name of the person addressed. In the same way the word "Subject" is written below and a brief description of the subject of the letter is given.

The body of the letter is the letter proper.

The signature is that of the writer. If the rank and regiment corps or detachment of the writer have been given in the brief, it should not be added with the signature.

General Rules

A letter is folded into three parts: the upper third containing the brief, is folded towards the back of the letter and the lower third containing the signature is folded up over the body of the letter. The foolscap size is folded into four parts.

Only one side of the paper should be used. A margin of about an inch and a quarter should be kept on both sides.

The ceremonial address "Sir" and all salutations are omitted.

The body of the letter is single spaced. If more than one paragraph they are numbered consecutively and a double space left between them.

Every statement should be as brief and concise as possible.

Military Channels

Unlike the business letter of the commercial world, the military letter does not always proceed directly from the writer to the person to whom it is addressed. Communications, whether from a superior to a subordinate or vice versa pass through the intermediate commanders. This mode of transmittal is known as Military Channels.

Any member of a company wishing to communicate with his Company Commander must first obtain permission from the first sergeant, one of whose duties is to see that the Company Commander is not annoyed with trivial matters which the Sergeant himself is able to settle.

In a post, if an enlisted man desires to communicate with the Commanding Officer, he addresses the letter to his Company Commander, or to the Commanding Officer (through military channels). Then the Company Commander, if the letter refers to a matter that he has no authority to handle, indorses it and forwards it by the first sergeant along with the morning report to regimental headquarters. The Commanding Officer of the regiment indorses the letter in turn and if unauthorized to dispose of it, forwards it to post or division headquarters (depending upon the form of the organization at the post.) There it is first handled by the Sergeant Major, who is the principal Assistant to the Adjutant, being responsible to him for the proper care and disposition of all records and correspondence at headquarters. The letter then goes to the Adjutant who approves or disapproves it by indorsement, and passes it back through the same channels, provided the communication covers a case upon which he has instructions and authority for action from the Commanding Officer. If the letter covers a special case over which he has no authority, he submits it to the Commanding Officer for action. When this is completed, the same disposition is made of the letter as before stated.

Correspondence in the field goes through the following military channels:

From Company Headquarters to Regimental Headquarters; to Division Headquarters to Commander-in-Chief of the Field Forces.

All communications from officers and enlisted men, outside of the War Department, intended for the Secretary of War or any bureau or office of the War Department, are addressed to the Adjutant General of the Army, except

where special authority has been granted for direct correspondence. Similarly all correspondence of the War Department with the Army is through or by the Adjutant General of the Army. The Adjutant General makes the proper disposition of any papers coming to his office. There is, however, no objections to a request being embodied in any communication sent to his office that the papers be acted upon or disposed of in a specific way.

Unimportant and trivial communications need not be forwarded to the Adjutant General of the Army simply because addressed to him. Department, district, and brigade commanders decide whether a communication is of sufficient importance to be forwarded. All communications should be returned through the channels by which they are forwarded. If an enlisted man does not know the exact method of addressing an official communication, he should address it to his Company Commander who will, if he approves the letter, forward it through the proper channels.

Indorsements

The above paragraph shows the reason for indorsements. An indorsement is a written expression of opinion upon the subject of the letter by an officer who receives an official communication for further transmittal or final decision.

The first indorsement should begin about one-half inch below the rank after the signature of the writer of the letter, and succeeding indorsements should follow one another serially with a space of about one-half inch between indorsements.

Indorsements are numbered serially and show the date, place, and to whom written, with the signature of the writer. In making indorsements of a routine nature, the attachment of the initials is sufficient for the signature. (M. Q. M. C. 323.)

Inclosures

It sometimes happens that in addition to indorsements, supporting evidence in the form of records, affidavits, etc., is required. These are called inclosures, and they should be numbered and given proper office marks. (M. Q. M. C. 323).

Inclosures, together with the number of the indorsement to which they belong, should be noted on the back of the lower fold of the first sheet of the original communication. The total number of the inclosures accompanying a paper should be noted at the foot of each indorsement thereon. (Bulletin No. 24, W. D. 1912.)

Confidential Correspondence

A document or map marked "Secret" is for the personal information of the individual to whom it is officially entrusted, and of those officers under him whose duties it affects. The officer to whom it is entrusted is personally responsible for its safe custody, and should see that its contents are disclosed to those officers mentioned above, and to them only. The existence of such a document or map must not be disclosed by the officer to whom it is entrusted nor by his officers without the sanction of superior military authority. No document or map marked "secret" should be taken into the front line trenches in the theatre of war. A document or map market "secret" even though it may bear other classifying marks, such as "confidential" or "for official use only" must, nevertheless be regarded as "secret" within the meaning of this paragraph.

A document or map marked "confidential" is of less secret a nature than one marked "secret," but its contents will be disclosed only to persons known to be authorized to receive them or when it is obviously in the interest of the public service that they receive them. (M. Q. M. C. 292.)

The information contained in a document or map marked "for official use only" must NOT be communicated to the public or to the press, but may be communicated to any person known to be in the service of the United States, simply by virtue of his official position.

Documents and maps classed as "secret" or "confidential" must NOT be referred to in any catalogue or publication which is not itself a document marked "secret" or "confidential" as the case may be. An officer or soldier who communicates information contained in a document or map marked "secret" or "confidential" or "for official use" must at the same time inform the person or persons to whom he communicates the information that it is "secret" or "confidential" or "for official use only," as the case may be. The only legitimate use an officer or soldier may make of documents or information of which he becomes possessed in his official capacity is for the furtherance of the public service in the performance of his duty. Publishing official documents or information or using them for personal controversy, or for any private purpose without due authority, will be treated as a breach of official trust and may be punished under the Articles of War, or under Section I. Title of the espionage. (000 72 A. G. O.) (M. Q. M. C. 292.)

Penalty Envelopes

Official communications and other mailable matter relating exclusively to the public business will be transmitted through mails free of postage if covered by the "Penalty Envelope." Envelopes for official mail have "War Department," the name of the bureau or office of the department, and "Official Business" printed in the upper left hand corner and in the upper right hand corner the warning "Penalty for Private Use $300.00" hence the name "Penalty Envelopes." (M. Q. M. C. 324, 333.)

Par. 835, A. R. defines official information as "that which is intended for the performance of official duties only." Information intended for the furtherance of private interests or aims, even when called for by an officer or official of the War Department, is classed as private information and must be covered by the prescribed postage. In writing to any person from whom official information is desired, it is permissible to enclose a penalty envelope for the return of that information. This permission, however, does not include the furnishing of penalty envelopes to merchants or dealers to cover the transmission of public property or the return of official vouchers. (Par. 837, A. R.)

Telegrams

The telegraph and cable service will be used only in case of urgent necessity or when delay will hinder the business of the service and in cases where delay caused by using the mail will be prejudicial to the best interests of the service. Day telegrams should be sent only when night telegrams will not serve the purpose. Except in extreme necessity night telegrams should not be sent when the mail can be delivered the following morning. Night telegrams should be plainly indicated by the words "Night Telegram" being stamped thereon. When it is practicable to do so, telegrams from one office may be consolidated at the close of business and made the subject of one telegram, where such consolidation can be made without embarrassing the interests of the service. (Par. 334, M. Q. M. C.)

Government blanks should be used when practicable when sending official telegrams by those in the service of the War Department authorized to send such telegrams. They should be marked "Government Paid" but never "Government Collect." Commercial blanks, if used officially, should also be marked "Government Paid" on the face of the blank. Accounts for telegrams as military business, prepared on the prescribed form in the name of the telegraph company rendering the service and accompanied by the original telegrams, will be paid by the Depot Quartermaster, Washington, D. C.

Fort Niagara, N. Y.,

Jan. 7, 1916.

FROM: Mechanic James Andrews, Co. "A," 1st Inf.

TO: Comdg. Genl., Eastern Dept.

SUBJECT: Transfer.

1. I would request to be transferred to Co. "B," 2nd Inf.
2. My reasons for requesting this transfer are that I served an enlistment in that company, which is now stationed near my home, Sackets Harbor, N. Y.
3. I am serving my second enlistment period.
4. Date of present enlistment, Apr. 1/14.
5. I am enclosing a letter from my mother, who is an invalid, asking me to make the transfer, if possible.

JAMES ANDREWS.

1 Incl.

2123. 1st Ind.

Co. "A," 1st Inf., Fort Niagara, N. Y., Jan. 9/16. To Post Commander.

1. Character of soldier is "very good."
2. He is single.
3. Three years, Co. "B," 2nd Inf., Mach. 15/14. Serving his second enlistment period since Apr. 1/14.
4. Soldier has no convictions by court-martial; he is not under charge nor in confinement.
5. Soldier has sufficient funds to defray expenses incident to transfer.
6. Has not previously been transferred during his current enlistment.
7. Physical condition—good.
8. Authorized strength of company is 100; actual strength is 95.

HENRY A. DUBBS,
Capt., 1st Inf., Comdg.

1 Incl.

4356. 2nd Ind.

Hq. Fort Niagara N. Y., Jan. 9/16. To C. O., Madison Bks., N. Y.
Approved.

C. H. WELLER,
Col., 1st Inf., Cmdg.

1 Incl.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

ADMINISTRATION

LECTURE III

MILITARY LAW

A. Kinds of Military Jurisdiction.

B. Books Describing Military Jurisdiction.

1. U. S. Army Regulations.
2. Manual for Courts-Martial.
3. Articles of War.
4. Manual of Interior Guard Duty.
5. Field Service Regulations.

C. Courts-Martial.

1. Kinds.
2. Appointment.
3. Personnel.
4. Jurisdiction.
5. Punishments.

In civil life, conduct is regulated by the laws made by Congress, Legislatures, and governing bodies of smaller political organizations, such as the counties and cities and enforced by the police and when necessary by the aid of the militia or regular army. Offenders are tried by courts established for the purpose and punished according to the provisions of the law.

In the army conduct is regulated by a different set of laws designed for the particular purpose of controlling those under military jurisdiction. These laws are enforced by military authorities and offenders are tried by courts of a particular kind known as "Courts-Martial."

Military jurisdiction is in force at all times in the army and when special needs arise it is extended over civilians. It is divided into four classes.

1st—*Military Government.*—This is the form of government established in time of war over a conquered territory and its inhabitants. The laws are such as will get the maximum amount of assistance from the conquered people for the purpose of continuing the war. They are enforced by soldiers and offenders are tried by military commissions and provost courts.

2nd—*Martial Law at Home.*—This form of military jurisdiction is used to control the conduct of communities when the civil authorities are unable or for any reason do not exercise the necessary control. The laws are made and enforced by military authorities.

3rd—*Martial Law in the Army.*—This form of military jurisdiction is used to control persons in the military service who are in a state of insurrection or rebellion.

4th—*Military Law.*—Military law is the legal system that regulates the government of the military establishments. It contains the rules and regulations

by which every soldier is governed. It is both written and unwritten. The sources of written military law are the Articles of War enacted by Congress, the Army Regulations and General and Special Orders and decisions promulgated by the War Department, Post and other Commanders.

The books in which these laws, orders, rules, and regulations may be found are: Army Regulations, Manual for Courts-Martial, Manual of Interior Guard Duty, Field Service Regulations, and for the Quartermaster Corps, in the Manual for the Quartermaster Corps, U. S. Army.

Army Regulations.—In general the A. R. cover all matters pertaining to military discipline, rank or procedure, promotions, transfers, leaves of absence, and furloughs, responsibility and accountability, territorial divisions of the country and the various departments of the Army—in short, all matters touching on the instruction, organization and regulation of the military service. Every officer and enlisted man should know those parts which directly affect his position, duties and responsibility.

Article I is of particular interest. It covers the matter of military discipline. Paragraph 1 provides that "all persons in the military service are required to obey strictly and execute promptly the lawful orders of their superiors." Paragraph 2 provides that "military authority will be exercised with firmness and kindness and justice." Paragraph 3 insures the self-respect of the enlisted men by providing that "superiors are forbidden to injure those under their authority by tyrannical or capricious conduct or abusive language." Paragraph 4 states that "courtesy among military men is indispensable to discipline" and that it will be extended on all occasions. Paragraph 5 forbids deliberations among military men conveying praise or censure toward others in the military service.

The regulations when obeyed will insure discipline without which an army cannot be victorious.

THE MANUAL OF INTERIOR GUARD DUTY and THE FIELD SERVICE REGULATIONS will be discussed in detail in later lectures.

THE ARTICLES OF WAR are 121 in number and describe the particular offenses which are punishable by Courts-Martial and prescribe the authority of the court to impose punishment in each case. They are to be found in the Manual for Courts-Martial.

The following table will show some of the more common offenses, the punishment to be imposed, and the number of the Article.

OFFENSE	PUNISHMENT IN THE TIME OF WAR	Art. No.
Spies	Death	82
Desertions	Death or as a Court Martial directs	58
Advising or aiding another to desert	" " "	59
Assaulting or wilfully disobeying a superior officer	" " "	64
Mutiny or sedition	" " "	66
Misbehavior before enemy	" " "	75
Improper use of countersign	" " "	77
Forcing a safeguard	" " "	78
Aiding the enemy	" " "	81
Insubordinate conduct toward non-commissioned officers	As a Court Martial may direct	65
Absence without leave	" " "	61
Quarrels, frays, disorders	" " "	68
Drunk on duty	" " "	85
General article	" " "	96

The Manual for Courts-Martial stipulates the manner of securing justice for soldiers accused of violating the Articles of War.

There are three kinds of Courts-Martial—general, special and summary. The following table will show the main differences between them and the essential features of each.

KIND	Appointed By	Personnel	Jurisdiction	Maximum Punishment
General	C. O. of division or larger unit.	5 to 13 commissioned officers.	All persons in the military service.	Death.
Special	C. O. of regiment or larger unit.	3 to 5 commissioned officers.	All persons in the military service except officers.	6 mos. confinement 6 mos. pay.
Summary	C. O. of detached Co. or larger unit up to regiment.	One commissioned officer.	All persons in the military service except officers and non-commissioned officers who object thereto.	3 mos. confinement and loss of 3 mos. pay.

Only a general court-martial can impose a dishonorable discharge.

Besides the court itself every proceeding requires a judge advocate who is appointed by the same authority who appoints the court. The judge advocate represents the government, swears in the court, and is sworn in by the president of the court. His work corresponds to that of the prosecuting attorney in a civil court. He examines witnesses for the prosecution and cross examines witnesses for the defense.

The accused has the right of counsel. Any commissioned officer may be appointed to act as his counsel upon the request of the accused or the accused may hire a civil attorney for that purpose. The counsel advices the accused, examines the witnesses for the defense and cross examines the witnesses for the prosecution.

The accused may challenge the appointment of any member of the court and if it is shown that such member for any reason would not give an unbiased judgment he will be replaced.

All proceedings will be made a matter of record by the clerk of the court.

After hearing has been completed the court votes in the order of rank, the juniors voting first, on the charge of guilty or not guilty and then on the punishment to be imposed. A majority vote decides the case except in the case of a capital crime, when it requires two-thirds majority to convict.

The decision of the court is subject to review by the appointing authority and does not go into effect until approved by that authority.

The organization of the court and the procedure is such that impartial justice will be given and the accused may be sure of fair treatment throughout.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

ADMINISTRATION

LECTURE IV

GUARD DUTIES

OFFICERS.

Officer of the Day.
Commander of the Guard.

ENLISTED PERSONNEL.

Sergeant of the Guard.
Corporal of the Guard.
Sentinels.
Musicians.

COUNTERSIGNS AND PAROLES.

GENERAL AND SPECIAL ORDERS.

GUARDING PRISONERS.

FLAGS.

Garrison.
Post.
Storm.

It is probable that most soldiers will at one time or another be called upon to perform guard duty, hence the importance of this subject. Proficiency in these duties, however, cannot be acquired by any short cut methods, but can be attained by steady and untiring efforts to master the rules of the Manual of Interior Guard Duty and by actual experience in the capacity of sentinels.

Officer of the Day.—There is an officer of the day of each guard, who is responsible for the proper performance of duty by the guard assigned to him and for the enforcement of all police regulations. He is responsible to the Commanding Officer.

The Officer of the Day prescribes patrols and orders inspections to be made by officers and non-commissioned officers of the guard whenever he deems necessary. In case of alarm he takes the steps necessary for protection of life and property. He must keep the commander of the guard informed of his whereabouts at all times, in order that he may be reached in case of emergency.

Officers of the guard are assigned to it in accordance with the strength of the guard. If it be large enough each guard is assigned a commander and such subordinate officers as may be necessary. Officers of the guard must remain constantly with their guards.

Commander of the Guard.—The commander of the guard inspects the sentinels at reveille and retreat and at any other time he may deem necessary to assure himself that they are in proper condition. He questions his non-commissioned officers and sentinels regarding instructions they may have received from the old guard and supervises patrols, and visits of inspection ordered by the Officer of the Day.

Sergeant of the Guard.—The senior non-commissioned officer of the guard always acts as Sergeant of the Guard and if there be no Officer of the Guard performs the duties prescribed for the commander of the guard.

The position of Sergeant of the Guard is difficult and responsible. He has general supervision over the non-commissioned officers, musicians, and privates of the guard and must be thoroughly familiar with all their orders and duties.

He is responsible for all property under charge of the guard, for policing of the guard house, including the grounds and the prison cells. He reports to the commander of the guard any suspicious occurrence, warns him of the approach of armed troops and sends to him all persons arrested by the guard. He is directly in charge of the entire guard, supervising and inspecting its work and is responsible to the commander of the guard.

Corporal of the Guard.—The corporal of the guard is assigned to a relief consisting of the sentinels who are to guard certain posts. He sees that the relief is properly posted, that orders are properly transmitted from the old sentinel to the new. He inspects the members of his relief in the performance of their orders and duties. He assigns posts to each member of his relief. After posting the guards the corporal makes a report in duplicate concerning all members of his relief, including himself, giving the numbers of the relief, the name, company, post to which each is assigned. One copy of this report is given to the sergeant, the other is retained.

Each corporal must know all special and general orders pertaining to his relief. He will see that each one understands and transmits such orders in detail to his successor. The corporal is stationed near his relief and is called in all cases not covered by instructions.

Musicians of the Guard.—The musicians of the guard will sound calls as prescribed by the commanding officer.

Should the guard be turned out for national or regimental colors or standards, uncased, the field music of the guard will, when the guard present arms, sound "To the Colors" or "To the Standard," or if for any person entitled thereto, the march, flourishes, or ruffles, prescribed in paragraphs 375, 376, 377, A. R.

Countersigns and Paroles.—Forty-fourth Article of War. Any person belonging to the armies of the United States who makes known the watchword to any person not entitled to receive it according to the rules and discipline of war, or presumes to give a parole or watchword different from that which is received, shall suffer death or such other punishment as a courts-martial may direct.

The Countersign is a word given daily from the principal headquarters of a command to aid guards and sentinels in identifying persons who may be authorized to pass at night.

It is given to such persons as may be authorized to pass and repass sentinels' posts during the night, and to officers, and non-commissioned officers and sentinels of the guard.

The parole is a word used as a check on the countersign in order to obtain a more accurate identification of persons. It is imparted only to those who are entitled to inspect guards and to commanders of guards.

Thirty-sixth Article of War.—No soldier shall hire another to do his duty for him.

Privates are assigned to reliefs by the commander of the guard, and to posts, usually, by the corporal of their relief. They will not change from one relief

or post to another during the same tour of guard duty unless by proper authority.

Orders of Sentinels.—Orders for sentinels are of two classes: General orders and special orders. General orders apply to all sentinels. Special orders relate to particular posts and duties.

Sentinels will be required to memorize the following:

My general orders are:

1. To take charge of this post and all government property in view.
2. To walk my post in a military manner, keeping always on the alert and observing everything that takes place within sight or hearing.
3. To report all violations of orders I am instructed to enforce.
4. To repeat all calls from posts more distant from the guardhouse than my own.
5. To quit my post only when properly relieved.
6. To receive, obey, and pass on to the sentinel who relieves me all orders from the commanding officer, officer of the day, and officers and non-commissioned officers of the guard only.
7. To talk to no one except in line of duty.
8. In case of fire or disorder to give the alarm.
9. To allow no one to commit a nuisance on or near my post.
10. In any case not covered by instructions to call the corporal of the guard.
11. To salute all officers, and all colors and standards not cased.
12. To be especially watchful at night, and during the time for challenging to challenge all persons on or near my post, and to allow no one to pass without proper authority.

Sentinels posted at the guard will be required to memorize the following:

Between reveille and retreat to turn out the guard for all persons designated by the commanding officer, for all colors and standards not cased, and in time of war for all armed parties approaching my post, except troops at drill and reliefs and detachments of the guard.

At night, after challenging any person or party, to advance no one, but call the corporal of the guard, repeating the answer to the challenge.

Guarding Prisoners.—The sentinel at the post of the guard has charge of the prisoners except when they have been turned over to the prison guard or overseers.

1. He will allow none to escape.
2. He will allow none to cross his post leaving the guardhouse except when passed by an officer or non-commissioned officer of the guard.
3. He will allow no one to communicate with prisoners without permission from proper authority.
4. He will promptly report to the corporal of the guard any suspicious noise made by the prisoners.
5. He will be prepared to tell whenever asked how many prisoners are in the guardhouse and how many are out at work or elsewhere.

Whenever prisoners are brought to his post returning from work or elsewhere, he will halt them and call the corporal of the guard, notifying him of the number of prisoners returning. Thus: "Corporal of the guard, (so many) prisoners."

He will allow no prisoners to pass into the guardhouse until the corporal of the guard has responded to the call and ordered him to do so.

When not engaged in the performance of a specific duty, the proper execution of which would prevent it, a member of the guard will salute all officers who pass him. This rule applies at all hours of the day and night except in the case of mounted sentinels armed with a rifle or pistol, or dismounted sentinels armed with a pistol, after challenging.

Sentinels will salute as follows: A dismounted sentinel armed with a rifle or sabre, salutes by presenting arms; if otherwise armed, he salutes with the right hand.

Flags.—The garrison flag will have 38 feet fly and 20 feet hoist. It will be furnished only to posts designated in orders from time to time from the War Department, and will be hoisted only on holidays and important occasions.

The post flag will have 19 feet fly and 10 feet hoist. It will be furnished for all garrison posts and will be hoisted in pleasant weather.

The storm flag will have 9 feet 6 inches fly and 5 feet hoist. It will be furnished for all occupied posts for use in stormy and windy weather. It will also be furnished to national cemeteries. (A. R. 223.)

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

ADMINISTRATION (FOLLOWING LECTURE IV)

TYPICAL QUIZ QUESTIONS

Motor Truck Drivers' Course

1. How does a soldier on sentry or guard duty armed with a rifle salute?
2. Name the five ways in which diseases are contracted.
3. Name the parts of a letter.
4. What are military channels?
5. What is an indorsement?
6. Name the three classes of confidential communications.
7. Give three rules for the use of telegrams in government communications.
8. What is meant by military government?
9. Under what circumstances is martial law at home declared?
10. What are the Articles of War?
11. Give the powers of a summary court-martial.
12. May a special court-martial try officers; non-commissioned officers?
13. What are the duties of the officer of the day?
14. What are the duties of a corporal of the guard?
15. Give the twelve General Guard Orders.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

ADMINISTRATION

LECTURE V

CARE OF ARMS AND EQUIPMENT

General Care of Rifle Cartridges.

Ball.
Blank.
Guard.
Dummy.

Cleaning Rifle to Remove.

Powder fouling.
Metal fouling.

Solutions Used.

Soda.
Swabbing.
Standard Metal-fouling.
Nitro-Solvent.

Care of Leather.

The rifle now used by our Army is the model 1917 and is frequently referred to as the Enfield rifle as it is somewhat like the Enfield rifle and embodies some of the principal features of that rifle.

It has a range of almost two miles, but the best results are obtained at a range of not over 1200 yards.

The only parts of a rifle that an enlisted man is permitted to take apart are the bolt mechanism, and the magazine mechanism. It is essential that he learns to do this, for he must know how, in order to keep his rifle clean. Never remove the hand guard or the trigger guard, nor take the sights apart unless you have special permission from a commissioned officer.

Every part of the rifle must be kept free from rust, dust and dirt. A dirty or dusty rifle is a sure sign that a soldier does not realize the value of his weapon, and that his training is not complete.

The rifle you are armed with is the most accurate in the world today. If it is not kept properly clean, and is allowed to get dirty or rusty, it will deteriorate in its accuracy and no subsequent care will restore it to its original condition. The most important part of the rifle to keep clean is the bore. If the rifle is left overnight after having been fired in the afternoon, it will be badly rusted in the morning. Therefore, it is essential that the rifle be cleaned not later than the evening of the day it was fired. The fouling of the blank cartridge is as dangerous to the bore as the fouling of the ball cartridge.

Never polish any part of the rifle that is blued. If rust appears, remove it by rubbing it with oil. Never use emery paper, pomade, or any preparation that cuts or scratches, to clean any part of the rifle.

To beautify and preserve the stock, rub it with raw linseed oil. The use of any other preparation on the stock is forbidden.

Your rifle will be your comrade and life preserver throughout the service, and you should always handle it with care. Don't stand it up against anything so that it rests against the front sight. Don't leave a stopper or rag in the bore; it will cause rust to form at that point. It may also cause the gun barrel to burst if a shot is fired before removing it. Guard the sights and muzzle carefully from any blow that might injure them. The front sight cover is especially necessary to protect the sight while the rifle is being carried in the scabbard by mounted men. In coming to "Order Arms" lower the rifle gently to the ground. When there is a cartridge in the chamber, the piece is always carried locked, except when on the firing line. In this position, the safety lock should be kept turned full to the rear, since, if it is turned to the front nearly to the "ready" position and the trigger is pulled, the rifle will be discharged.

Cartridges cannot be loaded from the magazine unless the bolt is drawn fully to the rear. When the bolt is closed or partly open the safety lock may be turned up or down as desired; but if the bolt is drawn fully to the rear, the magazine cannot be cut off unless the top cartridge or the follower is pressed down slightly and the bolt is pushed forward so that the safety lock may be turned off.

Should your rifle misfire do not open bolt immediately, as it may be a hang fire. Misfire is often due to the fact that the bolt handle was not fully pressed down. Sometimes in pulling the trigger the soldier raises the bolt without knowing it.

On being relieved from duty unload arms before going to barracks or tents unless otherwise ordered.

There are four types of cartridges:

(1) *The ball cartridge* consists of the brass case or shell, the primer, the charge of smokeless powder, and the bullet. The bullet has a sharp point, is composed of a lead core and a jacket of cupro-nickel, and weighs 150 grains. The bullet of this cartridge, when fired from the rifle, starts with an initial velocity at the muzzle of 2700 feet per second.

(2) *The blank cartridge* contains a paper wad instead of a bullet. It is dangerous up to 100 feet. Firing with blank cartridges at a represented enemy at less than 100 feet is prohibited.

(3) *The guard cartridge* has a smaller charge of powder than the ball cartridge, and five cannelures encircle the body of the shell at about the middle to distinguish it from the ball cartridge. It is intended for use on guard or in riot duty, and gives good results up to 200 yards. The range of 100 yards requires a sight elevation of 450 yards, and the range of 200 yards requires an elevation of 650 yards.

(4) *The dummy cartridge* is tin plated and the shell is provided with six longitudinal corrugations and three circular holes. The primer contains no percussion composition. It is intended for drill purposes to accustom the soldier to the operation of loading the rifle.

All cartridges are secured five in a clip to enable five cartridges to be inserted in the magazine at one motion. Sixty ball cartridges in 12 clips are packed in a cloth bandolier to facilitate issue and carrying. When full the bandolier weighs about 3.88 pounds. Bandoliers are packed 20 in a box, or 1200 rounds in all. The full box weighs 90 pounds.

Keep the Working Parts Oiled.—In every company there should be at least one copy of the Manual of the Ordnance Department, entitled, "Description and Rules for the management of the U. S. Magazine Rifle." This manual gives the name and cut of every part of the rifle, explains the use, how to take the rifle apart and to care for it, and also gives much other valuable and interesting information.

Cleaning the Rifle.—The proper care of the bore requires conscientious and careful work; but it pays well in the attainment of reduced labor in the cleaning, prolonged accuracy, life of the barrel and better results in combat. Briefly stated, the care of the bore consists in removing the fouling resulting from firing, to obtain a chemically clean surface, and in coating this surface with a film of oil to prevent rusting. The fouling which results from firing is of two kinds: One, the products of combustion of the powder; the other, cupro-nickel scraped off (under the abrading action of irregularities or grit in the bore). Powder fouling, because of its acid reaction, is highly corrosive; that is, it will induce rust and must be removed. Metal fouling of itself is inactive, but may cover powder fouling, and prevent the action of cleaning agents, until removed, and when accumulated in noticeable quantities, it reduces the accuracy of the rifle.

Powder fouling may be readily removed by a scrubbing with hot soda solution, but this solution has no effect on the metal fouling of cupro-nickel. It is necessary, therefore, to remove all metal fouling before assurance can be had that all powder fouling has been removed and that the bore can be safely oiled. Normally, after firing a rifle, the barrel of which is in good condition, the metal fouling is so slight as to be hardly perceptible. It is merely a smear of infinitesimal thickness, easily removed by solvents of cupro-nickel. However, owing to the pitting, to the presence of dust and other abrasives, metal fouling may occur in clearly visible flakes or patches of much greater thickness, much more difficult to remove.

In cleaning the bore after firing, it is well to proceed as follows: Swab out the bore with soda solution to remove powder fouling. A convenient method is to insert the muzzle of the rifle into the can containing the soda solution, and with the cleaning rod inserted from the breach to pump the barrel a few times. Remove and dry with a couple of patches. Examine the bore to see that there are in evidence no patches of metal fouling, which, if present, can be readily detected by the naked eye; then swab out with the swabbing solution, a diluted metal-fouling solution. The amount of swabbing required with the swabbing solution can be determined only by experience, assisted by the color of patches. Swabbing should be continued, however, as long as the wiping patch is discolored by a bluish green stain. Normally a couple of minutes' work is sufficient. Dry thoroughly and oil.

The proper method of oiling a barrel is as follows: Wipe the cleaning rod dry; select a clean patch and thoroughly saturate it with sperm oil or warmed cosmic, being sure that the cosmic has penetrated the patch; scrub the bore with the patch, finally drawing the patch smoothly from the muzzle to the breech, allowing the cleaning rod to turn with the rifling. The bore will be found now to be smooth and bright, so that any subsequent rust and sweating can be easily detected by inspection.

If patches of metal fouling are found upon visual inspection of the bore, the standard metal fouling solution prepared as hereinafter prescribed must be used. After scrubbing out with soda solution, plug the bore from the breech with a cork at the front end of the chamber or where the rifling begins. Slip a 2-inch section of rubber hose over the muzzle down to the sight and fill

with the standard solution to at least one-half inch above the muzzle of the barrel. Let it stand for 30 minutes. Pour out the standard solution, remove hose and breech plug, and swab out thoroughly with soda solution, to neutralize and remove all trace of ammonia and powder fouling. Wipe the barrel clean, dry, and oil it. With few exceptions one application is sufficient, but if all fouling is not removed as determined by careful visual inspection of the bore and of the wiping patches, repeat as described above.

After a proper cleaning with either the swabbing solution or the standard solution as has just been described, the bore should be clean and safe to oil and put away; but as a measure of safety, a patch should always be run through the bore on the next day and the wiping patch examined to insure that cleaning has been properly accomplished. The bore should then be oiled, as described above.

If the swabbing solution or the standard metal-fouling solution is not available, the barrel should be scrubbed, as already described, with the soda solution, dried, and oiled with light oil. At the end of 24 hours it should again be cleaned, when it will usually be found to have "sweated," that is, rust having formed under the smear of metal fouling where powder fouling was present, the surface is puffed up. Usually, a second cleaning is sufficient, but to insure safety it should again be examined at the end of a few days, before final oiling. The swabbing solution should always be used, if available, for it must be remembered that each puff when the bore "sweats" is an incipient rust pit.

A dry, clean surface having been obtained, to prevent rust it is necessary to coat every portion of this surface with a film of neutral oil. If the protection required is but temporary and the arm is to be cleaned or fired in a few days, sperm oil may be used. This is easily applied and easily removed, but has not sufficient body to hold its surface for more than a few days. If rifles are to be prepared for storage or shipment, a heavier oil, such as cosmic, must be used.

Where arms are being prepared for storage or shipment they should be cleaned with particular care, using the metal fouling solution, as described above. Care should be taken, insured by careful inspection on succeeding day or days, that the cleaning is properly done and all traces of ammonia solution removed. The bore is then ready to be coated with cosmic. At ordinary temperatures, cosmic is not fluid. In order to insure every part of the surface being coated with a film of oil, the cosmic should be warmed. Apply the cosmic first with a brush, then with the breech plugged, fill the barrel to the muzzle, pour out the surplus, remove the breech block, and allow it to drain. It is believed that more rifles are ruined by improper preparation for storage than from any other cause. If the bore is not clean when oiled, that is, if powder fouling is present or rust has started, a half inch of cosmic on the outside will not stop its action, and the barrel will be ruined. Remember that the surface must be perfectly cleaned before the heavy oil is applied. If the instructions as given above are carefully followed, arms may be stored for years without harm.

Preparation of Solution

Soda Solution.—This should be a saturated solution of sal soda (bicarbonate of soda). A strength of at least 20 per cent is necessary. The spoon referred to in the following directions is the model 1910 spoon issued in the mess outfit. Sal soda, one-fourth pound, or four heaping spoonfuls. Water, 1 pint

or cup, model 1910, to upper rivets. The sal soda will dissolve more readily in hot water.

Swabbing Solution.—Ammoniam persulphate, 60 grains, one-half spoonful smoothed off. Ammonia, 28 per cent, 6 ounces, or three-eighths of a pint, 12 spoonfuls. Water, 4 ounces, or one-fourth pint, or 8 spoonfuls. Dissolve the ammoniam sulphate in the water and add the ammonia. Keep in a tightly corked bottle, pour out only what is necessary at the time, and keep the bottle corked.

Standard Metal-Fouling Solution.—Ammoniam persulphate, 1 ounce, or two medium heaping spoonfuls. Ammonium carbonate, 200 grains, or 1 heaping spoonful. Ammonia, 28 per cent, 6 ounces, or three-eighths pint, or 12 spoonfuls. Water, 4 ounces, or one-fourth pint, or 8 spoonfuls.

Powder the persulphate and carbonate together, dissolve in the water, and add the ammonia, mix thoroughly and allow the mixture to stand for one hour before using. It should be kept in a strong bottle, tightly corked. The solution should not be mixed with unused solution, but should be bottled separately. The solution, when mixed, should be used within 30 days. Care should be exercised in mixing and using this solution to prevent injury to the rifle. An experienced non-commissioned officer should mix the solution and superintend its use.

Neither of these ammonia solutions have any appreciable action on steel when not exposed to the air, but if allowed to evaporate on steel they attack it rapidly. Care should therefore be taken that none spills on the mechanism and that the barrel is washed out promptly with soda solution. The first application of soda solution removes the greater portion of the powder fouling and permits a more effective and economical use of the ammonia solution. These ammonia solutions are expensive and should be used economically.

It is a fact recognized by all that a highly polished steel surface rusts much less easily than one which is roughened. Also that a barrel which is pitted fouls much more rapidly than one which is smooth. Every effort, therefore, should be made to prevent the formation of pits, which are merely enlarged rust spots and which not only affect the accuracy of the arm, but increase the labor of cleaning.

The chambers of rifles are frequently neglected because they are not readily inspected. Care should be taken to see that they are cleaned as thoroughly as the bore. A roughened chamber lessens greatly the rapidity of fire and not infrequently causes shells to stick.

A cleaning rack should be provided for every barrack. Rifles should always be cleaned from the breech, thus avoiding the possible injury to the rifling at the muzzle which would affect the shooting adversely. If the bore for a length of six inches at the muzzle is perfect a minor injury near the chamber will have little effect on the accuracy of the rifle. The rifle should be cleaned as soon as the firing for the day is completed. The fouling is easier to remove then, and if left longer it will corrode the barrel.

The principles as outlined above apply equally well for the care of the barrel of the automatic pistol. Special attention should be paid to the cleaning of the chamber of the pistol, using soda solution. It has been found that the chamber pits readily if it is not carefully cleaned, with the result that the operation of the pistol is made less certain.

Care of Leather

General.—Because of the value of leather equipment and its rapid deterioration if neglected, the proper care of leather is most important.

Materials.—Two agents are necessary to the proper cleaning of leather—a cleaning agent and an oiling agent.

The cleaning agent issued by the Ordnance Department is castile soap; the oiling agents are neat's-foot oil and harness soap.

The soap cleans the surface of the leather, and removes from the surface pores of the leather dirt, sweat, and other foreign matter, so that the oil can more readily penetrate the pores and saturate the fibers, thus making the leather pliable and elastic.

Cleaning.—Daily, or as often as used, leather equipment should be wiped off with a cloth slightly dampened in water, merely to remove mud, dust or other foreign substances.

This daily care will do much to maintain the appearance of the equipment, but it is, however, insufficient of itself to properly preserve it.

Leather should never be cleaned by immersing in water or holding under a hydrant.

At intervals of from one to four weeks, depending upon the circumstances, it is essential that the equipment be thoroughly cleaned in accordance with the following instructions:

(*a*) Separate all parts, unbuckle straps, remove all buckles, loops, etc., where possible.

(*b*) Wipe off all surface dust and mud with a damp (not wet) sponge. After rinsing out the sponge, a lather is made by moistening the sponge in clear water, squeezing it out until nearly dry, and rubbing it vigorously upon castile soap. When a thick, creamy lather is obtained, thoroughly clean each piece of the equipment without neglecting any portion. Each strap should be drawn its entire length through the lathered sponge so as to actually remove the salt, sweat, and dirt from each leather piece.

(*c*) After again rinsing the sponge make a thick lather as described above with saddle soap. Go over each separate piece, thoroughly working the lather well into every part of the equipment, remembering that its action is that of a dressing.

(*d*) After the leather has been allowed to become partially dry, it should be rubbed vigorously with a soft cloth to give it the neat, healthy appearance that is desired.

Oiling.—If the foregoing instructions have been carefully followed, the appearance should now be perfect, and if the leather is soft and pliable nothing further is required. It will be found, however, that it will be necessary from time to time to apply a little oil. It is not practicable, owing to different conditions of climate and service, to prescribe definitely the frequency of oiling. It has been found that during the first few months of use a set of new equipment should be given at least two applications of oil per month. Thereafter it is entirely a matter of judgment as indicated by the appearance and pliability of the leather. Frequent, light applications are of more value than infrequent heavy applications.

New Equipment.—Before using, perfectly new equipment should in all cases be given a light application of neat's-foot oil; soap is unnecessary because the leather is clean. The application of oil is important because leather equipment frequently remains a considerable time in an arsenal or depot and in spite of periodical inspections and rubbing it is probably too dry for severe service.

How to Apply Oil.—The quantity of oil to be used cannot be definitely prescribed. If not enough oil is used, the leather will be stiff and brittle; if too much is used, it will soil the clothing and accumulate dirt. The leather should, therefore, be saturated with sufficient oil to be soft and pliable without excess sufficient to cause it to exude.

In applying the oil the following general instructions should govern:

(*a*) The oil should be applied to the flesh side of the equipment where practicable when the leather is clean and still damp after washing (about half dry), because it penetrates more uniformly when applied from the flesh side, and when the leather is damp. If the leather is dry it will absorb the oil like blotting paper, preventing proper distribution.

(*b*) The oil should be applied with an oiled rag or cotton waste by long, light, quick strokes—light strokes, so that the pressure applied may not squeeze out an excess of oil; quick strokes, so that the leather may not absorb an undue amount of oil. The endeavor should be to obtain a light, even distribution.

(*c*) After applying the oil the leather equipment should be allowed to stand for 24 hours, if practicable, in a warm, dry place. It should then be rubbed with a dry cloth to remove any unabsorbed oil.

Points to be Remembered.—Therefore, from what has been said, the following points must be remembered:

(*a*) Keep leather clean.

(*b*) Keep leather pliable by frequent applications of oil.

(*c*) Use only materials furnished by the Ordnance Department. *Shoe polishes*, etc., are almost invariably injurious.

(*d*) *Dry all leather wet from whatever cause, in the shade;* never in the sun or close to a steam radiator, furnace, or boiler.

(*e*) Leather should habitually be stored in a cool, dry place, *without artificial heat.*

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

ADMINISTRATION

LECTURE VI

RESPONSIBILITY.

CARE OF CLOTHING AND EQUIPMENT

General.—A soldier's clothing and equipment are issued to him by his Government for certain purposes, and he has, therefore, no right to be in any way careless or neglectful of them.

The importance that the Government attaches to the proper care and preservation of the soldier's clothing and equipment is shown by the fact that the matter is made the subject of one of the Articles of War, the 84th, which prescribes that any soldier, who, through neglect, loses or spoils his arms, clothing or accoutrements, shall suffer such punishment as a court-martial may direct.

Clothing.—Every article of clothing in your hands should receive as much care and attention as you give your person.

Not only will your clothes last longer if properly cared for, but you will look neater and better dressed, which will add much to your military appearance.

Pressing.—Occasional pressing helps to preserve and freshen clothes, it puts new life into the cloth. Woolen uniforms when worn regularly should be pressed about once a week. In a company where there is an iron for general use there is no reason why every soldier should not press his own clothes.

Chevrons can be cleaned by moistening a clean woolen rag with gasoline and rubbing the parts and then pressing with a hot iron.

Leggins.—When soiled, leggins must be washed. If the leggins are allowed to dry without being wrung out, they will look better.

The service hat and the overseas cap should be frequently brushed. If the service hat becomes out of shape, the brim should be pressed and the crown blocked if necessary.

Shoes.—Shoes should at all times be kept as clean as conditions permit. Russet shoes should also be kept well polished, and field and marching shoes well oiled. Neat's-foot oil is very good for the leather, increasing its pliability and life and helps to turn water.

Perspiration.—Shoes becoming damp from perspiration should be dried naturally by evaporation. It is dangerous to dry leather by artificial heat. Perspiration contains acid which is harmful to leather, and shoes should be dried out as frequently as possible.

Wet Shoes.—Wet or damp shoes should be dried with great care. When leather is subjected to heat, a chemical change takes place, although no change in appearance may be noted at the time. Leather when burnt becomes dry and parched and will soon crack through like pasteboard when strained. This applies to leather both in soles and uppers. When dried the leather should always be treated with dressing to restore its pliability. Many shoes are burned while on the feet, without the knowledge of the wearer by being placed

while wet on the rail of a stove or near a steam pipe. Care should be taken while shoes are being worn never to place the foot where there is danger of their being burned.

Mess Equipment

Knife.—The knife blade is made of tempered steel, and when put away for a long period should be covered with a light coating of oil to prevent rust. Keep your knife clean by washing in soap and water after every meal. Do not use the blade as a pry. If the point is broken, grind the blade down to a new point.

Fork.—Keep your fork clean by washing with hot water and soap after every meal. Never use the prongs of your fork for prying open tops of cans, extractng corks, etc.

Don't permit your knife, fork or spoon to remain in vinegar or other foodstuffs for a long period, as verdigris will form. This corrodes the metal and is poisonous.

Spoon.—Keep your spoon clean by washing with soap and water after every meal.

Meat Can.—Do not carry meat of any kind or other greasy substance in the meat can for a long period, as it will corrode the aluminum. If the rivets securing the hinges to the meat can become loose, a few blows with a hammer or hand ax on the outside ends of the rivets, the heads of the rivets being backed up on a piece of metal, will tighten them.

If the hinge pin becomes loose, a nail can be used to replace it, the nail being cut with a service wire cutter and the ends of the nail headed over slightly with a few blows of a hammer.

Bacon Can.—The interior of the bacon can should always be kept clean and free from hardened grease or dirt by frequent washings with soap and water.

If the cover becomes loose on the body of the can, the upper half of the body may be bent out until the cover is again tight.

If the cover is too tight, a slight amount of flattening with a hammer on the edge of the cover, resting on a wooden block, will usually extend the cover sufficiently.

Condiment Can.—When not in use, always remove the contents. Many cans have been ruined by neglecting to do this.

See that the threaded ends do not become rusty.

The can should be disassembled at all inspections, so that the inspecting officer may see that no rust is present.

Cup.—The cup is made of aluminum and excessive heat damages aluminum. In using the cup for cooking never allow the contents to evaporate entirely. In other words, never hold an empty cup over a fire.

Keep your cup clean with hot water and soap—preferably H. & H. soap.

Canteen.—Although as a rule, only soap and water should be used in cleaning aluminum, a little sand can be used to advantage in cleaning the canteen.

Particular attention must be taken to see that canteens are properly cleaned after they have been filled with coffee, milk or any other fluid containing organic matter.

Being made of aluminum, the canteen is easily dented, and care must be taken to prevent this.

When not actually in use the canteen should habitually be emptied and the cup left off to dry.

Responsibility for M. T. C. Property

The term "responsibility" as used in this lecture implies a military and pecuniary obligation on the part of a person to control and preserve material entrusted to his care in such manner as to best serve the interests of the army. There will be a great many persons who will not be required to render accounts for motor vehicles entrusted to them, but the fact that such a person is not required to render an account or return of said property in no sense relieves him of the responsibility, as above defined, which is automatically imposed upon him when any Government property comes under his care or control, nor of the obligation to maintain according to conditions of the service, a reasonable record or statement of his stewardship, or to furnish evidence, when properly called for, of the disposition which he has made of motor vehicles, parts, tools or accessories for which he is responsible.

The only way to insure satisfactory service from motor vehicles is to maintain them in the most scrupulous state of cleanliness, lubrication, and adjustment, and to devote timely attention to the condition of the tires, brakes, and minor repairs, in order to defer, as long as possible, the inevitable withdrawal of the vehicles from service for overhauling, and to prevent breakdowns on the road at a critical time.

Unnecessary damage to vehicles and excessive demands for spare parts, repairs and replacements are certain indications of unskillful use of equipment, just as large consumption of fuel and supplies, in proportion to the known transportation needs of a command, are taken to indicate waste and improper supervision and control.

In order to properly maintain the vehicles in serviceable condition, and to increase the number of days per year that they are in good operating condition, constant vigilance is necessary in detecting and reporting trouble and sending vehicles in ample time to service parks for repair or replacement of necessary parts. Vehicles should be sent to service and overhaul parks periodically, and should not be kept running until they break down or wear out, unless the exigencies of the service so demand.

General Principles of Care and Upkeep

Vehicle Maintenance.—(*a*) The general principles of good upkeep are the same for all motor vehicles. Certain routine operations *must* be periodically attended to by each driver. The necessary upkeep schedule to be followed is outlined below, and this procedure must be faithfully adhered to and constantly checked up by means of inspections. A copy of this Care and Upkeep outline should be a part of the equipment of each vehicle.

(*b*) Intelligent upkeep and repair demand a *thorough knowledge* of the particular type of vehicle operated by the company. For this reason each company will be supplied with a set of instruction books issued by the manufacturer. The company commander should fully realize that important minor repairs must often be made under trying circumstances, and by the drivers, unassisted by the company mechanics. This demands a knowledge of the car used, and the responsibility for adequate instruction of the men is upon the shoulders of the company commander.

(*c*) Much time ordinarily wasted by drivers waiting for their trucks to be loaded and unloaded, should be used to good advantage for lubrication, minor repairs, adjustments and general cleaning.

(*d*) Company commanders should most strongly impress upon their drivers the responsibility which the latter have for several thousand dollars' worth of equipment, and that this equipment at certain times may have a value which cannot be measured in dollars, owing to the urgent needs which may arise for its employment. In consequence, each driver should understand that his responsibility for his vehicle, is similar to that of a naval officer in charge of his vessel; that no matter what the circumstances are attending, damage to his vehicle or loss of equipment, a thorough investigation will be made, even though he is ultimately exonerated with honor. It should be made plain to him that excuses cannot be taken for ignorance of rules, failure to keep proper distance, to maintain proper speed, and to keep his vehicle absolutely under control at every moment that he is operating it. He is not only pecuniarily responsible for any damage which he allows to occur to the public property under his care, but he is also subject to disciplinary action for carelessness or negligence of duty in allowing this valuable property confided to him to be damaged. Ordinarily, no explanation is acceptable for damage to a vehicle, other than a collision by another vehicle, which the driver could not with all his skill and judgment avoid, or damage by hostile fire.

Rules.—The following rules are for the guidance of drivers, as well as for officers and non-commissioned officers. They represent the minimum of attention which must be given to vehicle maintenance, and will serve as a basis of inspection, and company commanders will see that they are carried out:

(*a*) Care must be given to *appearance*, as well as to mechanical perfection. See that the body and wheels are cleaned of dirt, and inside of body cleaned out.

(*b*) Be on the lookout at all times for all leaks, and for unusual noises; find the cause *immediately* and remedy it.

(*c*) In screwing up grease cups always make sure that the grease has actually been forced into the bearing.

(*d*) Never cut out the muffler.

(*e*) Never, under any circumstances, fill the gasoline tank or work on the carburetor in the presence of a naked flame or an oil lantern. If this work must be done in the dark, use an electric torch.

Log Book.—A log book is supplied for each vehicle. It must remain with the vehicle at all times, and the driver will be disciplined if it is lost. In it is entered a record of all repairs of any consequence made on the vehicle.

Motor Cycle Drivers' Course

ADMINISTRATION

LECTURE VII

Duties and Responsibilities

The general practice is to make each motorcycle driver responsible for the operation, care and upkeep of the motorcycle and equipment, as well as all other property assigned him. The extent of the repairs that the drivers should be required to make depends much upon their ability and training. In general, however, this will extend to what are classed as minor repairs, not requiring a more extensive mechanical knowledge than is possessed by the ordinary driver. Work on the motor, ignition and electric lighting system, or on the interior mechanism of running parts should normally be done under the direct supervision and orders of the mechanic. Aside from this it is better for the chief of section to determine the proficiency of the individual driver before permitting any repair, except the most simple, to be performed by him. Beware of the work of amateur experts.

The motorcycles of each section are under the direct supervision of the assistant cycle-master (chief of the section), who is held responsible for their upkeep and repairs. Likewise, the mechanic, with the assistant mechanics, has a general supervision over the mechanism of the motorcycle equipment, as well as the detailed repair work devolving on them.

Relations With Service Park

Each motorcycle company will be assigned by the Motor Transport Officer of the division, or other unit served by the company, to a definite service park. For all repairs which would consume more than one working day in the company's shop, the disabled vehicle must be sent to the assigned service park.

In case a motorcycle must be sent to a service park for repair, if possible the service park will substitute another motorcycle in its place, on M. T. C. Memorandum Receipt, and the vehicle turned in will be held on M. T. C. Memorandum Receipt (Form M. T. C. 101).

Companies will be outfitted with spare parts, M. T. C. supplies, and material whenever possible according to standard lists, which are prepared by the Maintenance Division, Headquarters M. T. C. One copy of these lists should be kept by the company commander and one by the property sergeant. Requisitions for parts, supplies, and material shall be made out on Q. M. C. Form 160, by the property sergeant on the mechanic's recommendation, and signed by the company commander. These requisitions will be forwarded as often as desirable to service park to which the company is assigned. Stock on hand, plus unfilled requisitions, should equal the standard lists and should form the basis of inventory.

When any part shows undue wear or breaks, or any trouble or suspected trouble develops beyond the facilities at hand, the part must be replaced, or motorcycles must be sent immediately to the assigned service park for replacement or repair.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

ADMINISTRATION

LECTURE VIII

STOLEN PROPERTY AND ACCIDENT REPORTS

(*a*) Instructions to Chauffeur. M. T. C. N. 140a-b.

(*b*) Stolen property report. M. T. C. No. 111.

(*c*) Drivers' Accident Report. M. T. C. No. 124.

Note: The three forms covered in this lecture are to be introduced into class, carefully looked over and discussed.

Instructions to Drivers of Automobiles and Motorcycles

M. T. C. Form No. 140A-B

These cards are self explanatory. Each driver should be supplied with a copy of these instructions, and it is his duty to faithfully comply with these instructions.

Stolen Property Report

M. T. C. Form No. 111

The purpose of this report is: (*a*) to furnish information to the nearest Assistant Provost Marshal in case of stolen property, to aid in its recovery.

(*b*) To inform the Office of the Director, Motor Transport Corps, of the loss of M. T. C. equipment, in order that they may take steps to provide for necessary replacement, and in order to insure necessary corrections in the files of Registration and Organization cards.

(*c*) This report is used by all officers or other persons responsible for motor vehicles or equipment of same in cases where this property is stolen.

(*d*) Four copies of this report will be made out and disposed of as follows:

1. The original copy will be forwarded to the Director, Motor Transport Corps.

2. The second copy will be forwarded to the Motor Transport Officer of the Section in which the vehicle is operating, or, in case the property stolen was assigned to a Division, Corps, Army, Corps Troops or Army Troops, to the Motor Transport Officer of the unit to which the vehicle was assigned when stolen. All officers receiving this report will take such measures as may be possible under the circumstances, to aid in the recovery of the stolen property.

3. The third copy will be turned over immediately to the Assistant Provost Marshal whose headquarters are located in the territory where the property was stolen.

4. The fourth copy will be retained by the officer or other person making out the report.

(*e*) This report will be filled out properly, giving as much detail as possible, and delivered in person or mailed as "URGENT OFFICIAL MAIL."

Drivers' Accident Report

M. T. C. Form No. 124

This form is used to serve as instructions for drivers as to their procedure in case of injury, however slight, caused by their vehicles to persons, animals or property; and to serve as the written report of the accident.

The form is filled out by the driver immediately after the accident, and delivered to the commanding officer of his organization, who will certify on the form the date and hour of receiving the report.

The importance of making out this report promptly is emphasized by the fact that commanding officers are directed to institute court-martial proceedings against drivers who fail to render such report immediately upon return to organization.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

ADMINISTRATION

LECTURE IX

M. T. C. PAPER WORK

A. G. O. 29	Service Record.
M. T. C. 130	Personnel Report for Enlisted Men.
A. G. O. 637	Individual Equipment Record.
Q. M. C. 41	Soldier's Deposit Book.
	Log Book.
M. T. C. 117	Daily Receipts and Issues of Gasoline, Lubricants, etc.
M. T. C. 120a-b	Commutation of Rations and Lodgings for Drivers.
M. T. C. 124	Driver's Accident Report.
M. T. C. 111	Stolen Property Report.
Q. M. C. 509	Delinquency Record.
A. G. O. 594	Records of Court-Martial.
A. G. O. 525	Honorable Discharge.
Q. M. C. 370	Final Statement.

The following is a brief description of the most important forms from the standpoint of the driver, used in the administration of a motor transport company.

Service Record, (Form A. G. O. 29).—When a soldier is enlisted or re-enlisted, a service record on this form is opened for him by the recruiting officer, who fills out the descriptive list, Prior Service, and the first part of the current enlistment. All other data called for will be filled from time to time by the soldier's company or detachment commander, and must be entered promptly and accurately. Each entry made under Military Record, Allotments, and Clothing Account, must be initialed by the officer making the entry. When a soldier is transferred or detached from his company, the company commander will fill out the proper indorsement and forward the Service Record to the soldier's new commanding officer. A copy of each indorsement will be kept by each officer forwarding a Service Record. Each indorsement will give the authority for the change of station or status of the soldier, his character, and a full statement of his accounts at the time.

M. T. C. Personnel Report for Enlisted Men, (M. T. C. Form 130.)—This report is to be used only in case of enlisted men in the M. T. C., and is to be forwarded to the Director, M. T. C. It shows the man's qualifications and experience.

Clothing Record—Individual Equipment Record, (A. G. O. Form 637).—One of these forms is made out for each man in the company and contains an exact list of his equipment both of quartermaster property and ordnance property. The soldier places his initials at the bottom of the column where items are charged to him, as does the commander of his company. This is done each time articles are issued to the soldier (not in exchange for worn out articles), and each time the soldier turns in articles an entry to that effect is made on the form, initialed in the same way.

The form itself is attached to the soldier's service record and becomes a part of it. The soldier is thereafter responsible for every item charged against him and must be able to produce them on demand. If he loses or injures them through neglect, he must pay for them.

Soldier's Deposit Book, (Form Q. M. C. 41).—Any soldier may deposit with the quartermaster a sum not less than five dollars at any one time to bear interest at the rate of four per cent per annum on all sums on deposit for six months or more. A soldier's deposit book will be furnished to every soldier making such deposits, such deposits to be receipted for by the Quartermaster and attested to by the company commander. The book is kept by the soldier and must be presented with his Final Statement for payment. It cannot be assigned or transferred, nor can the soldier withdraw the money until he is separated from the service.

Log Book.—A log book is issued for each motor vehicle in the A. E. F. which bears the same relation to the vehicles that the service record does to the enlisted man. This book must at all times remain with the vehicle, and it is of the utmost importance that all data required be entered promptly and accurately by a responsible person. It shows transfers of the vehicle and spare parts provided or repairs made on it. A durable envelope is furnished with every log book, and it has a definite place on the vehicle. Care must be used in handling this book to keep it as clean as possible.

Daily Receipts and Issues of Gasoline, Lubricants, etc., (Form M. T. C. 117). —This is a daily record of gasoline and supplies received and issued by a company. It is to be kept by the supply sergeant and turned in to the organization office at the end of the day, the information consolidated on M. T. C. Form No. 118. The driver must sign for these items on this form whenever he receives them either in his own company or from some refilling station.

Commutation of Rations and Lodging for Drivers, (Form M. T. C. 120a-b). —Form 120a is to be used as a voucher for the payment of commutation of rations and lodgings for soldiers travelling under special orders, specifically directing the soldier's travel either with or without officers. Upon completion of the trip it will be certified to by an officer, in accordance with printed directions on the inside of the cover. The original and one carbon copy are to be given to the soldier for presentation to the disbursing officer in order that the soldier may be paid the commutation due him. The third copy is forwarded to the commanding officer of the organization to which the soldier is assigned for rations.

Form M. T. C. 120b is used for commutation of rations and lodging for a soldier traveling as driver to an officer, in case the travel performed by the soldier is not specifically covered by the order directing the travel of the officer or the vehicle. This form is to be filled out and certified to as per directions printed on the inside of the cover. The disposition of the copies is the same as for form 120a. It is important for the driver to be sure and get these forms made out at once, as otherwise the officer whom he has driven may not be available to sign them and the driver will therefore never be able to collect this commutation.

Driver's Accident Report, (Form M. T. C. 124).—This form is used to serve as instructions for drivers as to their procedure in case of injury, however slight, caused by their vehicles to persons, animals or property, and to serve as their written report of the accident. The form is to be filled out by the driver immediately after any accident, which results in injury to persons or

property. It is then delivered to the commanding officer of his organization, who will certify on the form the day and hour of receiving the report. Failure to make out this report immediately will result in disciplinary action being taken against the driver.

Stolen Property Report, (Form M. T. C. 111).—This report will be made out in case of any article of M. T. C. property which has been stolen. Four copies will be made, the disposition being as follows: original and second copy forwarded to H. Q., M. T. C., the third copy to be turned over immediately to the Assistant Provost Marshal of the territory in which the property was stolen, the fourth copy to be retained as a record for the company. This record must be filled out and mailed promptly.

Delinquency Record, Enlisted Men, (Form Q. M. C. 509).—In the office of the company is kept a loose leaf file of this form with the name of each man on a separate sheet. Whenever the man commits an infraction of the rules, that fact is entered on the sheet together with the penalty inflicted. The purpose of it is twofold—first, to determine the punishment to be inflicted; thus, a man who is a frequent offender will get a more severe punishment than a first offender; second, to be able to determine at a glance the character of the man for purposes of promotion or indorsement on service record in case of transfer. It therefore behooves every man to see to it that his delinquency record remains free from entries, for his own advancement depends entirely upon it, and every offense he commits is noted and remains a permanent blot on his record.

Records of Court-Martial, (Form A. G. O. 594).—A copy of all charges preferred against men in the organization, Form A. G. O. 594, must be kept as a permanent record. It is prepared in triplicate, one copy is retained in the office appointing the summary court, one copy forwarded to the Adjutant General, and the third copy returned to the company. It includes a statement of charges preferred, with a record of the disposition of the case by the court-martial, and is attached to the service record of the man.

Honorable Discharge, (Form A. G. O. 525).—An honorable discharge is given to every soldier discharged from the Army when his conduct has been such as to warrant accepting him for re-enlistment, and his service has been honest and faithful.

Final Statement, (Form Q. M. C. 370).—The final statement is a statement of his account with the United States given every enlisted man on his discharge or furlough to the regular army reserve, and is the voucher on which he is paid. It is made out in duplicate and both copies must be presented for payment. It contains a statement of clothing account, pay, deposits, etc. The soldier's immediate commanding officer will have the statement prepared and will certify to its correctness. No final statement is given in case there is nothing due the soldier, but a letter to that effect is given him. The soldier takes the final statement to the Quartermaster for settlement. He may, if he desires, assign or sell it to some other individual, but this has to be done in a certain way, otherwise the assignment is invalid. The easiest way for the soldier to have his accounts settled is to take them directly to the Quartermaster.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

ADMINISTRATION

TYPICAL QUIZ QUESTIONS (FOLLOWING FINAL LECTURE)

1. What are the four types of cartridges?
2. What is powder-fouling?
3. What is metal-fouling?
4. What means are taken to keep arms in perfect shape?
5. What two agents are necessary for the proper cleaning of leather?
6. Give three rules for cleaning leather.
7. Give two rules for oiling leather.
8. What is meant by responsibility?
9. Give three rules for the proper maintenance of motor vehicles that should be followed by drivers.
10. What is a log book?
11. What are the duties of the first sergeant?
12. What are the duties of mechanic and assistant mechanics?
13. What are the duties of the property sergeant?
14. What are the duties of the chiefs of sections?
15. What are the duties of drivers?

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

ADMINISTRATION

TYPICAL WRITTEN EXAMINATION QUESTIONS

1. Give the rules for the proper hand salute.
2. Name the five qualifications upon which ability is determined in the army.
3. What is meant by the brief of a letter?
4. Give the channels through which a letter from an enlisted man requesting a furlough would pass, assume that the enlisted man is a member of a motor transport company which is a part of a motor command in a camp in this country.
5. Write a military letter requesting a furlough; add one indorsement.
6. Give the rules that should be observed in the handling of secret communications.
7. Give the rules that should be observed in the handling of confidential communications.
8. Under what circumstances may a private individual use a penalty envelope?
9. Give the kinds of courts-martial and the number of men comprising each.
10. What are the powers of a general court-martial?
11. What does Army Regulations cover?
12. When does a decision of a court-martial go into effect?
13. What is a countersign; a parole?
14. Give five rules to be followed by a sentinel guarding prisoners?
15. Write a short treatise on the care of arms and equipment.
16. Give five rules for the care of clothing.
17. Outline the duties and responsibilities of the non-commissioned staff of a motor transport company.
18. What is the stolen property report Form M. T. C. 111; when is it used and what disposition is made of the various copies?
19. Tell all you know about the drivers' accident report Form M. T. C. 124.
20. What data is given in A. G. O. Form 637 individual equipment record?
21. Tell all you know about Form M. T. C. 120a and 120b, commutations of rations and lodgings for drivers.
22. What is a delinquency record Form Q. M. C. 509?
23. What is a record of court-martial A. G. O. 594?
24. Under what circumstance is an honorable discharge given?
25. What is a final statement Q. M. C. Form 370?

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Enlisted Men's Course

Motor Cycle Drivers' Course

LABORATORY

EXERCISE I

INTRODUCTION

a. Motorcycle Construction

1. *Motor.*—A combination of stationary, reciprocating, and revolving elements by means of which the burning of an explosive mixture of gasoline and air transformed into propulsive power.

(*a*) *Cylinder.*—A cylindrical cast iron member for carrying external flanges for radiation and cooling and accurately bored, and ground internally to permit the longitudinal reciprocating motion of the piston.

(1) Cylinder Head.—The upper part of the cylinder containing the valve pockets.

(2) Valve Pocket.—A projection from the cylinder head in which the valve pockets.

(3) Valve Seat.—A highly finished part of the valve pocket upon which the valve rests when in the closed position.

(4) Bore.—The diameter of the cylinder.

(5) Stroke.—The distance between the highest and lowest points of piston travel in the cylinder.

(*b*) *Piston.*—A cylindrical body accurately ground and finished upon its external surface. It is fitted to the cylinder in such a manner that it receives the force of the explosion and transforms the same into reciprocating motion.

(1) Piston Ring.—A circular cast iron member which fits into a groove around the side of the piston. It is split at one point of its circumference and is slightly larger than the bore of the cylinder. When introduced into the cylinder it forms a gas-tight seal, preventing the escape of gases between the cylinder wall and the piston wall. Three of these members are usually found upon each piston.

(2) Piston Pin or Wrist Pin.—A steel member passing through the piston laterally, which forms a bearing for the upper end of the connecting rod.

(*c*) *Connecting Rod.*—A steel member usually of I-beam cross section which connects the piston or reciprocating member with the fly-wheel or rotary member. The lower end of this member attaches to the crank pin, which forms a bearing on the fly-wheel.

(1) Connecting Rod Bearings.—There are two, the upper and lower bearings. A point or place of surface contact at which some means of reducing friction to a minimum is introduced.

(2) Piston Pin Bearings.—The point of contact between the upper end of the connecting rod and the piston pin.

(3) Crank Pin Bearing.—The point of contact between the lower end of the connecting rod and the crank pin.

(*d*) *Fly-Wheel.*—A heavy wheel mounted upon suitable shafts. It stores up energy on the working or power stroke and expends it during the other strokes in rotating the shaft for the remainder of the cycle.

(*e*) *Crank Pin.*—An eccentrically placed member holding the two fly-wheels together and forming a bearing for the lower end of the connecting rod. It corresponds to the throw upon the ordinary solid crank shaft found in automobile motors.

(*f*) *Main Shaft.*—A member centrally located in one fly-wheel upon one end, to the other end of which is attached the pinion gear for driving the timing gears of the motor.

(*g*) *Sprocket Shaft.*—A member centrally located in the other fly-wheel upon one end, to the other end of which it attached the sprocket actuating the driving chain of the motorcycle.

(*h*) *Crank Case.*—A chamber in which the shafts and fly-wheels are contained, and in which they revolve. It acts as a container for the motor lubricant and has lugs provided upon its outside surface to allow of the motor unit being securely attached to the frame of the vehicle.

(*i*) *Cam.*—A metal disc of irregular shape forged integral with an actuating pinion. It imparts a varying motion to the valve operating mechanism.

(*j*) *Roller Arm.*—A member in the form of a lever imposed between the cam and the valve operating push rod. Generally used as a means of multiplying the cam action.

(1) Exhaust Valve Roller Arm.—The roller arm operating the exhaust valve push rod.

(2) Intake Valve Roller Arm.—The roller arm operating the intake valve push rod.

(*k*) *Lifter Pin.*—A round steel rod used to transmit the action of the cam from the roller arm to the end of the valve stem. It is usually provided with a means of adjusting for wear. There are two for each cylinder, one operating the exhaust valve and the other the intake valve.

(*l*) *Valve.*—A conically shaped metal disc actuated by a rod attached to its center, which operates to open and close a passage to the interior of the cylinder.

(1) Exhaust Valve.—The valve used to open and close the passage by which exhaust gases leave the cylinder.

(2) Intake Valve.—The valve used to open and close the passage by which the explosive mixture enters the cylinder.

(3) Valve Springs.—A coiled member of spring wire which retains the valve in a closed position until the valve is forced open by the action of the cam.

(4) Valve Spring Collar.—A member for retaining the valve spring in place and exerting its tension upon the valve stem.

(5) Valve Cage.—A special member provided for the insertion of the overhead type of valve into the valve pocket. It is cylindrical in form and contains the valve seat and valve guide.

(6) Valve Guide.—A bearing for the valve stem.

(7) Valve Rocker Arm.—An externally located member used in overhead valve motors to transmit the action of the cam to the valve stem.

(*m*) *Oiler or Oil Pump.*—The mechanism used to draw lubricating oil from the supply tank and force the same into the crank case.

(*n*) *Magneto.*—An electrical instrument used for generating the current required to cause the spark which ignites the explosive mixture in the cylinder.

(1) Armature.—A rotating member composed of laminated discs of soft iron, upon which are wound coils of fine copper wire. When rotated in the magneto field it generates electric current.

(2) Breaker or Interrupter.—A mechanical device by means of which the continuity of flow of the primary current is periodically interrupted. It is operated by a cam located on the end of the armature shaft.

(3) Breaker Box.—The housing covering the breaker or interrupter mechanism.

(4) Brushes.—A carbon element used to gather and transmit electric current from a moving conductor. It makes contact with the collector ring on high tension magnetos.

(5) Condenser.—An electrical device used to prevent excessive sparking or arching at the contact points when they separate to break the primary circuit. It also tends to increase the intensity of the secondary current.

(*o*) *Carburetor.*—A mechanical apparatus for mixing liquid and air in such proportions as will produce an explosive mixture or gas.

(1) Needle Valve.—A part of a carburetor which provides a means of regulating the proportions of the liquid and air mixture.

(2) Float Chamber.—A chamber containing the float and fuel flow control mechanism.

(3) Float.—A cork or hollow metal member attached to a lever governing the flow of gasoline into the carburetor.

(4) Jet, or Spark Nozzle.—The orifice through which the fuel passes into the mixing chamber.

(5) Air Intake.—That opening in the carburetor by which air enters the mixing chamber.

(6) Throttle.—A valve interconnected with the gasoline control of the vehicle to regulate the amount of explosive mixture passing into the engine.

(7) Manifold.—A system of piping used to conduct the explosive mixture from the carburetor to the engine.

(*p*) *Frame.*—A system of tubes so arranged as to form a means of support or attachment of the wheels, power plant, tanks, and other members that go to make up the complete motorcycle.

(1) Top Tube.—The upper horizontal tube of a motorcycle frame extending from the head to the seat mast tube.

(2) Seat Mast Tube.—A vertical tube extending from the seat to the gear case bracket.

(3) Loop Tube.—A curved tube extending from the head down under the motor and connecting to the three-speed gear case bracket. It serves as a support for the motor.

(4) Head.—A forging in which the top tube and loop tube terminate at the front of the frame. It serves as a retaining member for the bearings upon which the front fork or steering members operate.

(5) Head Cup.—An accurately finished bearing member which is pressed into the head and which serves as a bearing support for the fork mechanism.

(*q*) *Forks.*—A set of movable tubular members controlled by the handlebars, to which are attached the front wheel, the entire combination forming the steering mechanism of the motorcycle.

(1) Rocker Arm.—Small levers provided at the bottom of the forks allowing the fork to spring to function.

(2) Fork Springs.—Springs provided in the fork mechanism to absorb road shocks.

(3) Fork Stem.—A tubular portion of the fork which is inserted into the head and upon which the head bearings are mounted.

(4) Lower Head Cone.—A conical bearing pressed onto the lower end of the fork stem.

(5) Upper Head Cone.—A conical bearing screwed onto the upper end of the form stem by means of which the adjustment of the head bearing may be effected.

(*r*) *Front Wheel.*—The front member used for steering.

(1) Front Hub.—The central member of the front wheel containing the front wheel bearings, and providing on its outside extremities a means for attaching the spokes of the wheel.

(2) Front Axle.—A steel bolt passing through the center of the front hub and for rocker arms and retaining the front wheel in place in the forks.

(3) Spokes.—Radical distance members connecting the front hub with the rim and holding the hub to its central location.

(4) Front Rim.—A circular rolled steel band of U-channel cross section so shaped as to permit the mounting of a clincher tire.

(5) Front Mud Guard.—A pressed steel member attached to the front forks and covering the front wheel in such a manner as to protect both mechanism and rider from road dirt.

(*s*) *Rear Wheel.*—The rear member used for driving the vehicle.

(1) Rear Hub.—The central member of the rear wheel containing the rear wheel bearings and providing on its outside extremities a means for attaching the spokes, brake mechanism, and rear driving sprockets.

(2) Rear Axle Drive Sprocket.—A toothed gear wheel fastened to the rear hub, which transmits the power of the engine to the rear wheel by means of a roller chain.

(*t*) *Brake.*—A mechanism for retarding the motion of the vehicle or for holding it at rest by means of friction.

(1) Brake Bands.—A flexible metal strap faced with a friction material.

(2) Brake Band Lining.—The material used to line the brake band.

(3) Brake Operating Lever.—A bell crank used to actuate the brake band.

(4) Brake Arm.—The arm forming part of the said plate of the brake and anchoring it to the frame of the motorcycle. It overcomes the tendency of the plate to turn when the brake is applied.

(*u*) *Transmission.*—A case containing a set of inter-meshing gears. An operating mechanism is provided allowing the driver to shift from one set of these gears to the other at will and by so doing to vary the ratio of engine speed to rear wheel speed.

(1) Gear Case.—The outer container of the transmission or gear set.

(2) Gear.—A cog wheel for transmitting power or motion.

(3) Gear Lock.—A special interlocking device provided upon some makes of motorcycle to prevent the shifting of gears while the clutch is still engaged.

(4) Spline Shaft.—A specially shaped steel shaft upon which the sliding members of the gear system operate.

(5) Gear Case Cover.—The top or lid of the gear case, through which an inspection of the unit may be made.

(6) Gear Case Retaining Bolt.—Special bolts provided in the top or the bottom of the gear case which serve to hold it in position in the frame.

(7) Gear Case Adjusting Screw.—Special adjusting device provided upon one side of the gear case to slide it backwards or forward for the purpose of adjusting the chains. This can be done only after the gear case retaining the belt nuts has been loosened.

(8) Inside Countershaft Drive Sprocket.—That sprocket upon the gear case that actuates the wheel drive chain.

(*v*) *Starter.*—A mechanical device provided upon the gear case to enable the driver to start the motor.

(*w*) *Clutch.*—A mechanical friction device that provides a means of gradually apply the power of the motor to the rear wheel and also a means of stopping and starting the vehicle without stopping the motor.

(1) Clutch Casing.—The housing containing the clutch mechanism.

(2) Clutch Sprocket.—A toothed gear riveted to the clutch housing.

(3) Clutch Plates.—Friction members of the clutch mechanism.

(4) Clutch Spring.—Small coiled spring used to vary the pressure between the clutch plates to increase or decrease the friction.

(5) Clutch Spring Adjusting Screw.—The screw used to regulate the tension of the clutch spring.

(6) Clutch Operating Thrust Bearing.—The small ball bearing located on the end of the clutch operating rod for taking the thrust load exerted on this rod.

(7) Clutch Operating Rod.—The small steel rod passing through the center of the splined shaft, which serves as an actuating member of the clutch mechanism.

(8) Outside Countershaft Drive Sprocket.—Same as clutch sprocket.

(*x*) *Chains.*—An assembly of rollers and sideplates riveted in position and forming a flexible metal belt.

(1) Engine Chain.—The chain used to transmit the power of the engine to the clutch mechanism.

(2) Main Drive Chain.—The chain used to transmit the power from the inside countershaft drive sprocket to the rear wheel.

(*y*) *Tanks.*—Containers for the fuel and lubricant supply.

(1) Gasoline Tank Dirt Trap.—A strainer device for separating foreign matter from the fuel.

b. Motorcycle Operation

(1) Indian Motorcycle.

1. If no side car is attached, put the motorcycle on its stand.

2. See that the clutch lever is engaged (at the rear of quadrant) and that the gear shift lever is in neutral position (second step from the top).

3. Turn on the gasoline by unscrewing one of the needle shut-off valves three or four turns. Draw up on the plunger of the grinding syringe in the left hand filler cap to load the syringe, then unscrew the cap. Open the primers or priming cocks and squirt a charge in each cylinder. Close the primers up tight after priming.

4. Pull out the starting stem on the carburetor and turn it until it rests on the guide. Push down on the priming pin slightly and hold it down for a second. Turn the right grip all the way outward (away from the machine) to lift the exhaust valves. Open the throttle slightly but turning the left hand grip inward (toward the machine).

5. Turn down the tread of the kick starter crank and press downward quickly on the crank. When the crank is half way down, turn the right hand grip all the way inward (toward the machine). Continue the thrust on the starter crank until it reaches the bottom.

6. If the motor will not start, or misfires when running or pops in the carburetor, run it for a little with the air valve button pulled out. Do not readjust the carburetor; the popping will disappear when the motor warms up. When the motor runs, release the foot from the starter crank and the latter will return to its upper position against the stop. When the motor warms up, turn the starting stem or air valve button until its pin fits in the slot in the guide, which is the normal position for the stem.

7. Nothing is to be gained by opening the needle shut-off valve more than three or four turns. The priming syringe should be screwed down in its place in the tank before the machine is started in motion.

8. In cold weather, the motor may need priming as mentioned above, but if the motor is warm and a re-start is to be made, it will not be necessary to inject gasoline with the syringe. In using the priming pin on the carburetor, do not jiggle the pin up and down, as nothing will be gained by so doing. One or two pressures as in paragraph 4 will flood the carburetor sufficiently to create a rich mixture which will be amply sufficient for starting purposes.

9. Raise and latch the stand and mount the machine.

10. Disengage the clutch by pressing down the left hand or clutch pedal as far as it will go. This withdraws the safety lock and disengages the clutch and permits the gears to be shifted. (*The clutch must always be disengaged before any attempt is made to shift the gears.*) Pull up on the gear shift lever at the right of the machine until it goes into the upper step on the quadrant (low speed). Open the throttle slightly and at the same time raise the left foot gradually when the motorcycle will move on the road.

11. When the motorcycle is running at about 10 miles per hour, close the throttle and depress the clutch pedal; then move the gear shift lever to the third step (intermediate speed) on the quadrant. As soon as the lever has reached that position, engage the clutch and open the throttle. To shift to high gear, proceed as above, except that the gear shift lever is to be moved to the lowest step on the quadrant.

12. The throttle must always be closed by the left hand grip before any gear shift is made. Always start on low gear, as it imposes the least strain on the driving mechanism.

13. To stop the machine, disengage the clutch by either the clutch pedal or clutch hand lever (at the right) and apply the brake with the right foot,

shift the gears to neutral position every time a stop is made, unless a re-start is to be made immediately.

14. To stop the motor, lift the valves by turning the right hand grip outward as far as it will go.

EXPLANATION

a. Four-Stroke Cycle Motor

The motorcycle now in use in the U. S. Army is the standard four-cycle engine. This engine goes through four different operations per impulse or two revolutions of the crank or fly-wheel. The first stroke is a suction or intake, the incoming gases are admitted by means of a valve operated by a camshaft. The length of stroke of the piston causes the suction by which the gases are drawn into the engine. The inlet valve is adjustable so as to regulate the proper amount of explosive mixture. When the fly-wheel or crank shaft has traveled or moved about 210° from top dead center the inlet valve should be just closed. That is, no more gases should be admitted through the inlet valve. Then the second stroke begins, compression stroke, which compresses the gases that are in the cylinder. Both valves are closed during this stroke. When the piston has reached top dead center the second stroke has been completed. The next stroke is the explosion or firing stroke or the impulse stroke. By use of an electric ignition the gases which have been compressed are caused to become ignited at the proper time. The igniting of the gases causes them to expand and in this expansion of gases the piston is compelled to move downward and being connected by a connecting rod to a crank shaft, it being connected by a train of gears with the camshaft which in turn controls the valves which regulate the operation of the motor. The fourth stroke begins when the piston on the third or impulse stroke is about 4/5 down and at this point the exhaust valve begins to open. This valve is open until the piston has reached top dead center again. The upward movement of the piston causes the burnt or exhausting gases to be expelled. This completes the four cycles or four strokes of a gasoline engine.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Enlisted Men's Course

Motor Cycle Drivers' Course

LABORATORY

EXERCISE II

MOTOR

a. Construction and Design of Parts

1. The motor fitted to all military models of the Indian motorcycle is of the two-cylinder, V type, 61 cubic inches piston displacement and operates on the four-stroke-cycle. The cylinders have their axes at an angle of 42 degrees with each other. The whole motor has the general form of the letter V, hence the name "V type."

2. The intake and exhaust valves in each cylinder are arranged side by side in a common valve chamber. On the front cylinder, the exhaust valve is in the right portion of the valve chamber, looking at the cylinder from the valve side, while the intake valve is in the left portion. On the rear cylinder, the exhaust valve is at the left, while the intake valve is at the right. This arrangement brings both intake valves in the most convenient position for attaching the intake manifold and getting an even supply of explosive mixture from the carburetor.

3. On the outer surface of each cylinder are cast a series of cooling flanges or ribs. These are cast in such a manner as to maintain as thin a cross-section as possible. Their purpose is to cool the cylinder by radiation. It is evident that the motor will be cooled efficiently only when the motorcycle is in motion. For this reason emphasis is put later on one point: Never allow any rider or driver to race his motor while the machine is standing nor to have the motor running idle over half a minute at one time.

4. A hole is bored and tapped in the center of each cylinder head. This hole is either fitted with a plug or a priming cock, and serves as an excellent place for inserting a scale to time the motor. When the priming cock is not fitted into the hole in the cylinder head, there is a priming valve fitted into a boss on the side of the cylinder head.

5. At the lower part or base of the cylinder is formed a flange, drilled with four holes. Studs are set in the motor base to correspond with the holes in the heavy cylinder flange, and these studs serve to secure the cylinder to the motor base. The inner surface or wall of the cylinder is very accurately finished. After each cylinder is bored, it is placed in an accurate grinding machine and the bore finished to one-thousandth part of an inch. This high finish is easily marred, so great care must be taken to keep the motor properly lubricated.

6. The piston is made of cast iron. There are three grooves to carry piston rings, all of which are above the wrist pin. The surface of the piston is accurately ground and finished. It has bosses on the inside through which are drilled holes for the wrist pin.

7. The wrist pin is a press fit into the piston, being held in place by a dowel. The surface of the wrist pin is ground to give a proper bearing surface for the bushing in the upper end of the connecting rod.

8. The connecting rods are of I-beam cross-section. The wrist pin bearing is a bronze bushing pressed into the upper end of the rod. The lower end of the connecting rod carries a sleeve, forming part of a roller bearing, the rollers being carried on the crank shaft.

9. One of the connecting rods has its lower end forked. A boss on its lower side prevents the forked ends from spreading. The other rod fits into the forked member. Both are thus independent, yet remain in their proper positions on the crank shaft. The connecting rod with forked end has a roller bearing sleeve on each of its ends, while the other rod has a sleeve for two sets of rollers. There are thus four sets of rollers on the crank shaft. The sleeves are of high grade steel, hardened and ground to size. The rollers are likewise hardened and ground, as is the crank shaft.

10. The four rows of rollers are fitted with retainers to keep them in their proper relation to each other. If this bearing develops play, it is possible to take this up by inserting oversize rollers which the manufacturers supply.

11. The crank shaft, in addition to acting as a bearing surface for the lower connecting rod bearings, serves to connect the two fly-wheels. It is tapered on both ends, each taper surface being accurately ground and registering with similarly tapered holes in the fly-wheels. A special nut and locking device prevents the crank shaft from working loose in the fly-wheels.

12. There are two fly-wheels in this type of motor. They are housed in the motor base. The fly-wheels are generally drop-forgings, but in some cases may be iron castings. Each fly-wheel has the necessary counter weights formed integral with it. At the center of each wheel is formed an accurately finished taper hole. The main shaft and pinion shaft (also called "center shaft") have tapered ends which fit their respective fly-wheels. These shafts are keyed in place in addition to the friction of the taper.

13. The main shaft fits in the fly-wheel at one end. It has a bearing in the motor base left half. Its projecting end is tapered and on it is carried the sprocket for the short drive chain. This sprocket is keyed on in addition to the taper and a nut and lock washer further assists in securing it in place.

14. The pinion shaft fits in the fly-wheel at one end. It has a roller bearing in the motor base right half. On its projecting end is keyed the pinion forming the first gear in the timing train.

15. The motor base bearing for the main shaft is a bronze bushing, while that for the pinion shaft is a roller bearing.

16. The motor base is of cast aluminum. It is divided into two halves vertically; that is, along the axis of the motor. When the halves are bolted together they form an oil-tight reservoir. The fly-wheels revolving in the motor base splash oil upon the other working parts.

17. Drilled lugs on the circumference of each motor base half permit halves to be bolted together. Anchor plates attach the motor base securely to the frame of the motorcycle. The upper part of each half is accurately machined and has four studs inserted. The cylinders fasten to the motor base by means of these studs and in such a position that their axes form an angle of 42 degrees. When prolonged, the axes will pass through the center line of the main and pinion shafts at the lower end. A chamber or casing is cast on one side of the motor base right half for housing the timing gears.

18. The bronze bushings in which the timing gears rotate are pressed into the walls of the chamber. The bushings for the lift levers, rockers and exhaust valve relief device are also pressed into the walls. The compression release valve bushing is pressed into a seat in a deep lug integral with the walls. The air relief tube has an opening into this chamber at the top. An extension of the timing gear casing at the lower part carries the mechanical oiler.

19. The intake and exhaust cams are formed integral with a gear driven directly by the pinion on the pinion shaft. This set of cams operates the valves of both cylinders. The gear on the pinion shaft and the gear having the cams in one piece with it are both marked so that when removed from the motor they may be replaced in their proper positions.

20. The intake and exhaust cams operate the valves once every two revolutions of the fly-wheels. The pinion shaft or centre shaft makes one revolution for every revolution of the fly-wheels; hence, it is necessary to use a gear which will revolve at one-half the speed of the pinion shaft. To do this we employ one with twice the number of teeth as are on the pinion shaft pinion, and it will take two revolutions of the fly-wheels to give one revolution of the cam gear.

21. In the upper part of the timing gear casing work the rockers and lift levers. These parts have short shafts which fit the bushings in the timing gear casing and cover. The cams operate the rockers directly, and these in turn move the lift levers. The toes of the lift levers operate the tappets in their turn.

22. The valve tappets are small hardened steel pins. On the upper end of each tappet are fitted adjusting nuts for regulating the "clearance" between the end of the tappet and the end of the valve stem. This clearance is necessary by reason of the expansion due to heat which might prevent a valve from seating properly unless a certain space is left between the parts mentioned. Therefore, the adjusting nuts are provided.

23. The valves work vertically in guides in a common valve chamber, intake and exhaust valves being side by side in each cylinder. To remove them, a hole is provided above each, in the upper part of the chamber. Each hole is threaded and in it is screwed a valve cap or valve hole plug. The plug or cap over the intake valve has the spark plug aperture formed in it. On top of the exhaust valve plug are cooling flanges to aid in cooling the exhaust valve.

24. The valve springs are of the spiral type. They bear against a sleeve at their upper end and against the valve spring collar at their lower end. This collar is held in place by two semi-circular keys which fit in a groove in the valve stem. The valve spring thus tends to keep the valve closed at all times. The action of the cam, rocker, lift rod and tappet opens the valve against the force of this spring.

25. The valves are of the mushroom type, with 45 degree seats. Both intake and exhaust valves are the same size. The stem, spring, tappet and adjusting nuts are protected from premature wear due to road grit by means of dust cover sleeves. These are telescopic to give access to the valves. When screwed in place they cover the exposed parts entirely.

26. In addition to the valve operating parts, the timing gear case houses other parts that perform important functions.

27. Between the two intake valve rockers is a short shaft having a toothed segment near one end. This segment meshes with teeth cut on the circumference of a cam plate, known as the exhaust valve relief cam. On the surface of the plate are formed cams which lift the exhaust valves through the rockers and lift levers and tappets when the plate is moved to a certain position. The

end of the shaft projects through the cover of the timing gear casing, and is squared to take a short lever operated from the grip control. This device enables the rider to lift the exhaust valves on the compression stroke of the motor, thus making it easier to start.

28. As mentioned above, the fly-wheels are contained in the motor base. They are of such size as to displace most of the air within it. The pistons in descending tend to compress the air in the motor base. If this pressure was not relieved efficient operation and lubrication of the motor could not be obtained.

29. This pressure is relieved by the compression release valve. This valve consists of a shaft which is bored nearly through its length and has two rectangular slots on opposite sides of the shaft. The slots communicate with the hole in the shaft. The compression release valve shaft works in a bushed lug formed in the timing gear casing, and is so placed in this lug that the hole opens into the motor base. The lug and its bushing have a slot to correspond with one of the slots in the valve at certain positions of the valve. The valve has a gear formed on its shaft which is driven by the cam gear. These two gears are so meshed as to open communication between the motor base and the timing gear casing when the pistons are descending in their cylinders. The release valve gear is so marked that if removed from the motor it may be readily replaced in its proper position.

30. The pressure from the motor base is relieved from the timing gear case by means of the air relief tube. This tube conducts the superfluous air and oil away from the case, across the top of the motor base between the two cylinders and ejects it on the front drive chain. The oil from this pipe lubricates the chain.

31. The mechanical oiler is carried in the lower extension of the timing gear casing. This is a plunger pump which draws oil from the oil tank and sends it to the rear wall of the front cylinder. It lubricates this cylinder and the oil drops to the motor base, where it is splashed to the rear cylinder and to the working parts.

32. The mechanical oiler is driven by a worm gear and driving block from a worm on the pinion shaft. The shaft of the worm gear has an eccentric pin for moving the driving block, thus giving the block a to and fro motion. The driving block has the pump plunger screwed in it, so that the plunger moves back and forth with it.

33. The end of the plunger opposite to that where it attaches to the driving block does the pumping. This end of the plunger moves in a cylindrical pump chamber provided with an intake port in its side near one end. Oil from the oil feed pipe can enter this port through an elbow connection at the lower side of the oiler body. At the end of the pump chamber is an outlet elbow in which there are two ball check valves for preventing the return of the oil to the pump.

34. The motion of the plunger to the right uncovers the intake port and draws in oil, while the motion to the left forces the oil out of the pump chamber, opening the outlet valves on its way and sends the oil to the front cylinder. The position of the plunger can be regulated by screwing it to right or left in the driving block. The alteration of the position of the plunger with relation to the intake port governs the amount of oil drawn from the oil feed line and sent to the motor.

35. On the front of the motor base is formed a bracket to which the magneto is bolted. The magneto is so mounted that the tapered end of its armature shaft extends into the timing gear case. When in place, a pinion, the

last in the timing train, is keyed on to this taper and a nut fitted to the end of the shaft further secures it. In order to have the spark pass at the spark plug at the proper instant, the magneto armature must be revolved in time with the motor. This will be described later.

36. The magneto pinion is marked to register with the mark on the idler or intermediate gear. This gear has marks to register with the magneto pinion and the release valve gear. When the marks on all five gears in the timing train are in register, both valves and magneto are properly timed.

37. A cover is provided for the timing gear casing. It is readily removable for inspection and adjustment of the parts within. This cover should not be removed for any reason except by an experienced motorcycle mechanic. If this warning is disregarded, serious trouble will result.

38. Midway between the cylinders and at the top of the motor is fitted the carburetor. It is bolted to a flange on the manifold. The carburetor and its method of adjustment is described later.

39. The curved manifold is clamped on the end of a manifold tube to each cylinder. Nuts hold the ends of these tubes to nipples in the valve ports, making air-tight joints. Great care is necessary in fitting these parts as air leaks at any of the joints will result in uneven running of the motor.

MOTOR TRANSPORT CORPS

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EXERCISE III

OPERATION

1. All motorcycles supplied for Government service, regardless of manufacture, are standard. There are two distinct types of cylinders in use in military motorcycles today. Both of these types, however, have the valves situated in a valve pocket. In one is the conventional "L" head design with the exhaust and intake valve side by side. In the other the intake valve is super-imposed on the exhaust valve and operated in a valve cage inserted in the cylinder. The discussion of these two types is taken up later under the head of valve design.

2. Upon the outer surface of the cylinder are found small fins or flanges. They are cast in such a manner that as thin a cross section of metal as possible is maintained. Their purpose is to cool the cylinder by radiation. It is obvious that this motor is cooled efficiently only when the vehicle is in motion. This is the reason that particular stress is laid upon this point. Never allow any driver to race his motor while the machine is not in motion and never leave the motor idling over half of a minute at one time. In the top of the cylinder provision is always made for a plug or pet cock. This hole, directly over the center of the piston, serves as a most excellent place to insert a scale when timing the motor. On the side of the cylinder is a small boss for the insertion of a priming cock. At the lower part of the cylinder a heavy flange is formed. Through this there are drilled four holes. Studs set in the crank case permit the cylinder to be securely fastened thereto. The inner surface of the cylinder, generally called the cylinder wall, is very accurately finished. After each cylinder has been bored, it is inserted in an accurate grinding machine and this surface finished to the thousandth part of an inch. This high finish is easily marred; hence, great care must be taken to be sure that the motor is being properly lubricated.

3. The piston of the military motorcycle is made of cast iron. It is conventional in design. Three grooves are provided for piston rings, all of which are above the piston pin. The surface of the piston is also very accurately ground and finished. Bosses are provided, through which are drilled the holes for the piston pin.

4. In motorcycle practice the pin proper is a press fit into the piston, being held in place by a special cotter key. The surface of the piston pin is ground so that it presents a suitable surface for the bushing provided in the upper end of the connecting rod.

5. The connecting rods are of I-beam cross section. The bronze bushing for the piston pin is pressed into the upper end of the rod. The lower end of the rod, or crank pin bearing, for many years baffled the best engineers to find a bearing that would give satisfactory results. The treatment of this particular part of the motor is an extremely interesting engineering attain-

ment. One of the rods is forked. A boss is provided on the lower side to prevent any tendency to spread. The other rod fits into the forked member. Both are independent, and in no way interconnected. Hardened steel bushings are pressed into these lower ends. The crank pin itself is of high grade steel, hardened and ground to size.

6. Four rows of rollers, in suitable retainers, provide the necessary bearing. If this bearing at any time develops any play, it is possible to take this up by inserting sets of oversize rollers which the manufacturers make up. Any handy man may perform the operation, since it does not require expert knowledge as is the case in scraping and fitting a bronze or babbitt bearing.

7. The crank pin, in addition to providing a bearing surface for the lower connecting rod bushing, also acts as a distance piece between two fly-wheels. It is tapered on both ends. This tapered surface is accurately ground and registers with similar tapered holes in each fly-wheel. A special nut and locking device obviates any possibility of this part working loose from vibration.

8. There are two fly-wheels in this type of motorcycle motor. They are entirely contained within the crank case. These wheels are usually cast; and necessary counter weights are provided for in this process. At the center of each wheel is provided a tapered and accurately finished hole. The main shaft and sprocket shaft have tapered ends which fit their respective wheels. In addition to this taper fit, all shafts, crank pin, main, and sprocket shafts are keyed in place in the fly-wheel.

9. The main shaft registers in the fly-wheel at one end. It provides a bearing surface for one of the crank case bushings; and upon its outer end is keyed and fastened the small pinion gear which operates the timing gears and the valve mechanism of the motor.

10. The sprocket shaft registers in its fly-wheel, and forms the bearing surface for the other crank case bushing. At its outer end on a ground taper with key is fastened the engine drive sprocket.

11. The crank case bearings for the main shafts are usually of bronze. The bearing of the sprocket shaft is annular, ball, or roller.

12. The crank case is usually of cast aluminum or cast iron. It is divided longitudinally into halves. When the halves are bolted together, they form an oil tight reservoir. The fly-wheels revolving in the case splash the oil upon the other working parts. Upon its outer surface are formed the holes or lugs which permit the motor to be bolted into the frame. The upper surface of the case is accurately machined and eight studs are inserted. The cylinders are fastened to the crank case by means of these studs, and in such a position that their center lines form an angle of 45 degrees. When extended both of these center lines will pass through the center line of the main and sprocket shafts. A chamber is cast upon one side of the crank case, in which provision is made for housing the cam and valve operating mechanism.

13. The studs or shafts upon which the various timing gears operate are securely fastened into this case. The stud upon which the cam revolves, sometimes called the cam shaft, is situated in the middle of the case and directly above the main shaft pinion gear.

14. The intake and exhaust cams are formed integral with the secondary pinion which operates them. This set of cams actuates the valves of both cylinders. The secondary gear or pinion, which is an integral part of this cam, meshes with the main shaft pinion. Upon all military motorcycles the cam gear is marked, so that when removed from the motor it can be replaced again in its proper position, relative to the main shaft pinion.

15. In the upper part of the timing gear case are found bushings provided for the valve lifter pins. The motion imparted by the cam is transmitted

to the lifter pins through a series of small levers, called lifter levers or roller arms. In one design these lifter levers have sliding contact with the cam face. In another design the ends of these arms are fitted with hardened steel rollers, which give a rolling contact between the roller arm and the cam face. The purpose of these lifter arms is to multiply the effect of the cam action. Considerable space and weight are saved by employing this type of design.

16. The valve-operating push rods are small hardened steel pins. On the upper end of each pin a screw adjustment is provided. A certain amount of clearance must be allowed between the end of the valve stem and this push rod; hence the adjustment.

17. Two distinctly different valve designs are used in military motorcycle engines. In one of these the conventional L head design is used with the intake and exhaust valves side by side in the cylinder pocket. To remove them from the cylinder a hole is provided in the top of the pocket. Special plugs are screwed into these holes. In the intake valve plug a hole is drilled and tapped to provide for this insertion of the spark plug. The valve springs are of conventional design. They are retained in tension by the valve spring collar. This collar is usually held in place by a small key passing through a hole milled near the end of the exhaust valve stem. Both valves are of the same size in this design. They are of the mushroom type and are provided with 45-degree seats. The stem and push rod mechanism is protected from premature wear from road grit erosion by means of the valve spring covers. These are telescopic in design. When screwed into place they cover the exposed part of the valve mechanism entirely.

18. In the second type of valve design the intake valve is mounted in a cage and is super-imposed on the exhaust valve. The exhaust valve is conventional and corresponds with the description of the previous design. Instead of having a plug inserted over the exhaust valve, however, the cylinder is machined out to permit the insertion of the intake valve cage. This cage sits in the cylinder in such a manner that no gaskets are required. The shoulder of the cage is ground into the seat so as to form a gas tight joint. A small housing which covers the intake valve stem and spring is inserted over the cage and the entire assembly locked in place in the cylinder by a special lock nut. A large hole is provided in the side of the cage, which registers with the intake manifold. This makes a passage for the gaseous mixture into the cylinder when the valve opens. The intake valve used in this cage is of the mushroom type. The valve head is equal in size to that of the exhaust valve, but the stem is much shorter. The valve being lighter, does not require such a heavy spring to operate. Hence the spring is smaller. The spring is retained in tension by means of spring collar and key.

19. The intake valve spring housing, previously mentioned, acts as a bracket to hold the intake valve operating the rocker arm. This is a small lever that transmits the action of the intake valve cam to take the end of the valve stem. Between this rocker and the end of the intake valve lifter pin in the timing gear is a long rod called the intake valve push rod. This rod is also provided with a screw adjustment which makes it possible to adjust the clearance between the rocker arm and the valve stem.

20. In addition to housing the valve operating mechanism, the timing gear case contains other parts that perform important functions.

21. As explained previously the fly-wheels of the motorcycle engine are contained within the crank case. They are of such size that they displace most of the air contained in it. The pistons are connected to the same crank pin; in their reciprocating motion both descend to the bottom of the stroke

at approximately the same time. This makes for a great variation in the amount of air contained in the case when the pistons are at the two extremities of the stroke. At a high number of revolutions per minute quite a heavy crank case pressure results. For efficient operation and lubrication this pressure must be relieved. In the military motorcycle this relief is accomplished by a rotary valve. This valve opens from the crank case into the timing gear case. It is of the rotary type and is formed integral with the pinion which operates it. In one make of motorcycle of military use this pinion is driven from the main shaft pinion. In another make it is found to be driven by the cam gear. The method of driving and placing the valve is entirely a matter of designing convenience. The operation of this valve, of course, is synchronized with piston action. The pinion is marked so that when removed from the motor it may readily be replaced in its proper position. This pressure is relieved from the timing gear case by means of a pipe at the top of the crank case. This pipe conducts the superfluous oily vapor away from the case, across the top of the crank case between the two cylinders, then downward to a point under the machine. In this way the oil is discharged on the road, leaving the engine base clean. In some motorcycles this oily vapor is used to lubricate the engine chain.

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EXERCISE IV

CARBURETORS, VAPORIZERS, ETC.

1. A carburetor or vaporizer is a device for combining air and hydro-carbon vapor to form a rapid burning or explosive mixture. Almost any hydro-carbon vapor when combined with air and compressed in a cylinder burns when ignited; but to obtain a maximum of efficiency from the engine the vapor or gas must be proportioned correctly for the degree of compression obtainable.

2. Carburetor is the name given the device which is used to mix air with the gas given off from a liquid fuel that evaporates only at a very low temperature, such as gasoline, benzine, and other light liquid fuels. Vaporizer is the name given the device which is used to mix air with gas given off from a liquid fuel such as kerosene, naphtha, and alcohol, that evaporates only at a comparatively high temperature. The vaporizer generally provides a means of heating the fuel to assist the rate of evaporation. Since they are not applied to motorcycle practice, no discussion regarding them is given.

3. A carburetor consists essentially of a bowl for holding the liquid fuel; a valve to control the flow of liquid into the bowl; an air passage leading across the surface of the liquid; a mixing chamber; a throttle valve; and a nozzle.

4. The bowl, called the float chamber, holds the liquid. As the height of the liquid in this bowl is of importance in obtaining the proper mixture, a valve connected to a float in the chamber automatically maintains a constant level of fuel. Means for adjusting the rise and fall of this float are provided, and any required level of fuel may be easily obtained.

5. The float may be of cork or a hollow cylinder. If of cork, it is treated with a coat of shellac to prevent the entrance of the liquid into the pores, which tends to destroy its buoyancy. The valve which is connected with the float has no other functions than to regulate the flow of the liquid into the float chamber from the fuel tank. It is so managed that when the fuel in the float chamber is being used the level tends to lower, the float drops a corresponding amount and automatically opens the fuel valve, allowing more fuel to flow into the float chamber and keeping the fuel level constant. A strainer is generally placed in the passage between the valve and the fuel tank to prevent the entrance of foreign matter.

6. From the float chamber the liquid is led to the spray nozzle through a suitable passage. The spray nozzle is a small tube with an aperture, of a size depending on the power of the engine, located at its upper end. This aperture may or may not be controlled by a needle valve. The spray nozzle being located in the air passage leading to the intake manifold, to increase the velocity of flow of the air column passing around the nozzle, two air inlets to the carburetor are provided, designed as primary and secondary air inlets.

7. The primary air inlet opens into the mixing chamber below the spray nozzle tip, and the secondary air inlet opens directly into the mixing chamber above the spray nozzle. The primary air inlet is generally a fixed opening,

or not subject to control or adjustment by the valve. The secondary air inlet is controlled by an automatic valve. Above the mixing chamber and the secondary air inlet is a valve, known as the throttle valve or butterfly valve. This controls the amount of mixture admitted to the engine. The mixing chamber is the space between the throttle valve and the spray nozzle, where the gas particles and air come into contact before entering the cylinder.

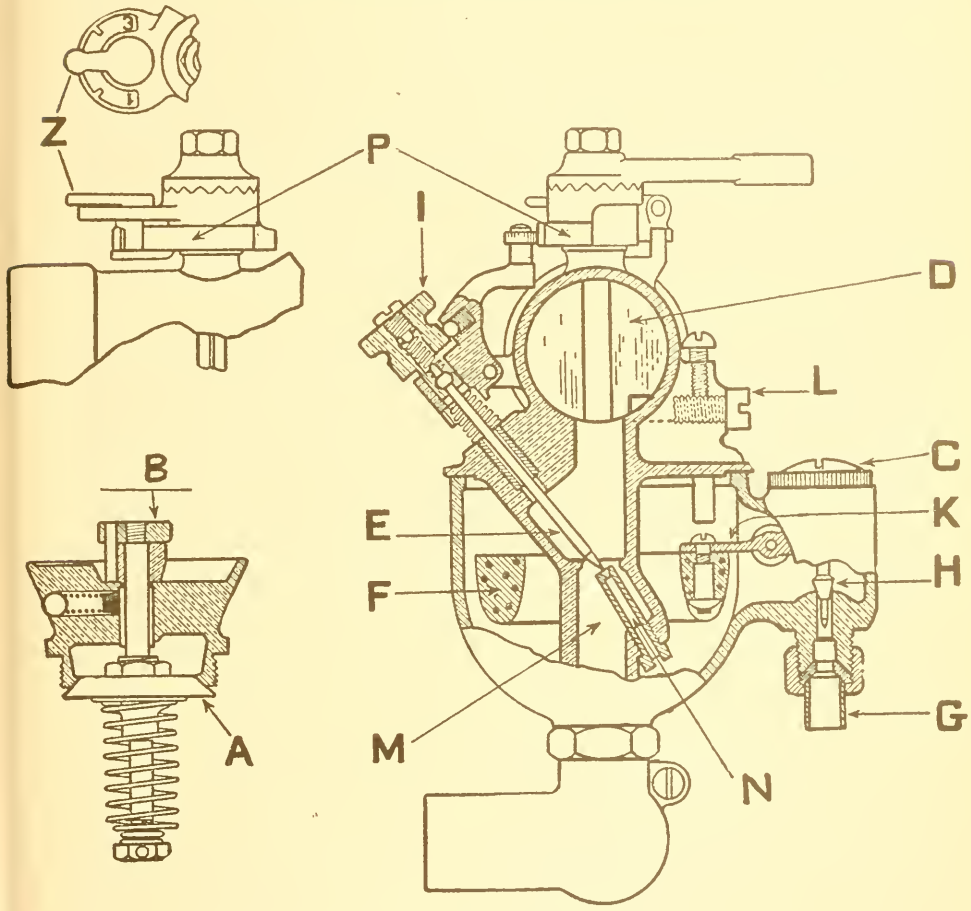
8. *Operation of a Typical Carburetor.*—Since the float chamber is connected with the fuel tank by a suitable pipe, controlled by a valve, the float chamber is filled with the liquid fuel. The weight of the float in the empty chamber, resting on the lever which carries the inlet valve, raises the valve from its seat, permitting the fuel to flow into the chamber. As the float rises, it causes the valve to close gradually until the fuel has reached the predetermined height in the chamber, at which point the valve is entirely closed against the flow from the fuel tank. The height of the fuel level in the float chamber is regulated so that the column of the fuel will rise in the spray nozzle to within about one-eighth or one-sixteenth of an inch of the tip opening.

9. With the formation of a vacuum in the cylinder and the inlet valve open, the pressure of the atmosphere forces a column of air through the primary air inlet of the carburetor. This air stream passes upward around the spray nozzle, acquiring an increase in velocity as it passes through the venturi tube. The orifice of the spray nozzle is located in the narrowest portion of the tube, therefore air passing by it at high velocity tends to draw through the orifice a quantity of gas particles, which, by the time they reach the mixing chamber, are thoroughly mixed with the air. The amount of gas particles drawn through the nozzle depends upon the velocity of the primary air stream and the height of the fuel in the nozzle tube. If the liquid stands at the normal height of three thirty-seconds of an inch from the orifice, and if there is a normal adjustment of the auxiliary air valve, a normal mixture is obtained. If a richer mixture is required, proportionally more gas must be admitted to the air stream; and the velocity of the air must be increased or the fuel level in the tube must be raised. To weaken the mixture the fuel is lowered, or the amount of primary air is reduced. Ordinarily, the height of fuel in the tube is adjusted for normal conditions and the required variations are made by adjusting the primary and secondary air flow.

10. The primary air intake being fixed, the adjustment is made by increasing or decreasing the tension of the auxiliary air valve spring. If the speed of the engine is increased, the suction effect through the carburetor is increased; and unless some means are provided to regulate the quality of the mixture, it soon becomes too rich. The auxiliary air intake, located above the spray nozzle and controlled by a spring, may be adjusted to allow the quantity of additional air required to equalize the quality of the mixture. By an increase of the quantity of air flow through the auxiliary air valve, less air is taken through the primary intake. Also the mixture is proportionately weaker in gas, giving less power to the engine, and economizing in fuel. By a decrease of air flow through the auxiliary air valve, an increase of flow of air through the primary air inlet is caused, enriching the mixture. This control of air flow through the auxiliary air inlet is automatic and varies with the speed of the engine. Its purpose is to maintain the same proportions of gas and air, regardless of the quantity of the mixture required for power or speed.

11. The throttle valve, controlled by the operator, is for the purpose of regulating the quantity of mixture entering the cylinder. To increase the speed of the engine more fuel is required and the throttle is opened until the desired speed is obtained; also, when more power is required, a greater quan-

tity of the mixture is admitted. A mixture too weak in gas burns slowly and lacks power; one too rich in gas also causes sluggish action of the engine. For different engines the proper proportion of gas and air varies from one part of gas to from seven to sixteen parts of air. Not all engines operate satisfactorily on the same quality mixture, owing to the difference in compression, cooling and individual characteristics. The efficient operation of any carburetor depends upon its proper adjustment for one particular engine.



Schebler Carburetor, Showing Construction

12. The carburetor in each machine is properly adjusted when it leaves the factory, and under ordinary circumstances should not require any readjustment. Occasionally, however, a change in adjustment becomes necessary for some reason or other, and the operation should be performed by a man experienced in carburetor adjustments.

13. After the motor has started and has become warm, the button "B" may be released and returned to its normal position. The use of this device in no way alters the adjustments of the carburetor.

14. If the motor misses and back fires because it is cold, run it for a little while with the knob "B" in the outer position. Do not be misled into readjusting the carburetor under such conditions. Let the motor warm up first; then it will run smoothly.

15. The gasoline is vaporized into a gas by the suction caused by the down stroke of the piston in the cylinder, which draws a fine spray of gasoline from the carburetor nozzle "N" through the tube "T" into the mixing chamber "M." Here it meets a current of cold air rushing in the auxiliary air valve (sometimes called compensating air valve) "A." The "mixture" continues on through the intake manifold to the cylinder, entering the combustion chamber through the intake valve. By the time the "mixture" reaches the combustion chamber, it is, or rather should be, a pure gas or explosive mixture.

16. When a motor is cold, a certain amount of condensation of the mixtures takes place in the intake pipe; and unless the motor is "primed" direct, by inserting a small amount of gasoline in each pet cock, it is difficult to start the motor.

17. See that the leather air valve "A" seats firmly but lightly, and that the brass hexagon nut firmly clamps the valve on to the bushing. Then turn the knurled button "I" to the right until the needle "E" seats in the spraying nozzle, cutting off the flow of gasoline. Now turn "I" to the left about three turns and open the low speed adjustment screw "L" about three turns, or 1/16 inch from the body of the carburetor. Then open the throttle about half way to start the motor. After starting the motor, close the throttle and turn the needle valve adjusting screw "I" to the right until the mixture becomes so lean that the motor back fires or misses. Then turn the knurled button "I" to the left, notch by notch, until the motor runs smoothly. If, with this low speed adjustment, the motor runs too fast, turn the low speed adjusting screw "L" to the right, as may be necessary.

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EXERCISE V

FUEL AND FUEL TROUBLES

A clogged gas line means that the motor will not run at all, will run for a while and then stop, or, if the flow is only slightly retarded, the motor will slow down and it will be impossible to adjust the carburetor satisfactorily, especially for high speed.

If the carburetor floods and the carburetor primer is not sticking, thereby holding down the float and thus causing flooding, the carburetor should be inspected as follows:

Remove the carburetor as explained later in this article. Remove the hot air connection and the bowl clamp nut. Take off the bowl with the float assembly. Turn the bowl bottom end up and try to blow through that part to which the gasoline pipe connects. If there is an air leak, the float valve is not seating firmly. Then try to force the float valve on to its seat by raising the float, and repeat the test. If the float valve still leaks, remove the float lever pin, then the cap "F" and the nut clamping the float valve to the float lever. Remove the float valve and the float with the lever. Inspect the seat of the float valve and remove all dirt and other foreign matter. Fit the float lever pin in the float lever and see that the fit is free.

If the test referred to,—namely, to force the float valve on to its seat,—proved that the flooding was not due to a faulty float valve or to dirt, inspect the float carefully. See that the shellac with which the float is coated has not cracked or peeled, allowing the gasoline to saturate the cork. A gasoline logged float does not close the float valve at the correct gasoline level, thereby causing flooding. A gas logged float must be thoroughly sandpapered, left to dry, and reshellaced.

If these suggestions do not apply, measure the distance from the top of the float in its raised position at a point opposite the float valve, to the top of the bowl. The correct distance is 19/32 inch. If necessary, bend the float lever carefully to get the correct level.

Disconnect the throttle control and the gasoline pipe from the carburetor. The carburetor can then be removed readily by taking out three screws with which it is fastened to the intake manifold. These screws are readily accessible from the right side of the motor. In this operation do not lose or damage the paper gasket between the carburetor and the manifold.

On account of the large amount of sediment and water which is in all gasoline and which causes most so-called "carburetor trouble," it is advisable to use a fine brass strainer in the funnel with which the gasoline tank is filled.

Recently it has been definitely ascertained that gasoline in going through a chamois skin generates static electricity, which, under certain conditions, can cause a terrific explosion. For years it has been customary to use chamois for straining gasoline; but it is only recently that scientists have discovered this as a cause of a number of bad explosions.

Never fill your gasoline tanks near an open flame. If your machine is equipped with any lights other than electric, be careful to have the light out when filling the tanks. If you spill any gasoline when filling the tanks, be careful to wipe off all the parts which the gasoline reached. Also wait a full ten minutes before starting the motor, so that there will be no chance for any gasoline vapor which may have accumulated near the machine to become ignited.

Go over the gasoline pipe and carefully shut off the valves each day before starting your motor, to see that there is not the slightest gasoline leak. Sometimes the gasoline line becomes damaged without the rider knowing it, causing a small leak; and it is best to be on the safe side and examine these parts carefully each day before starting out. If you locate a leak, remedy it at once before using the machine.

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EXERCISE VI

IGNITION

A. General Discussion on Electricity.—All internal combustion engines in use at the present time have some form of electric ignition, in which a current of electricity is made to produce a spark inside of the cylinders. All ignition systems are made up of two essential parts:

(1) The source of electric current supply;

(2) The apparatus for utilizing this current to produce a spark in the cylinder.

Before considering the features of either of these component parts it is necessary that an understanding be had of the fundamental electrical principles and definitions governing the construction and operation of electric ignition systems. An electric current flowing in a wire can be compared to water flowing in a pipe line. As the water pressure is measured in pounds per square inch, so the electrical pressure in a wire is measured by a unit called a volt. It is the practical unit by which electrical pressures are measured. The ampere is the practical unit by which the rate of current flow in a wire is measured. It corresponds to the number of cubic feet or gallons which flow through a water pipe per unit of time. For a large number of amperes a large wire is necessary and for a smaller number of amperes, a smaller wire can be used. We can have a small wire carrying a current of high voltage and a large wire carrying a current of low voltage, just the same as a large or small pipe can carry water of either high or low pressure. The size of wire determines the quantity of current it can carry. A small wire can carry a small current, but it requires a large wire to carry a large current. The ohm is the unit by which the resistance to the flow of electric current through a wire is measured. It corresponds to the friction opposing the flow of water through a pipe. The ampere-hour is the measure of quantity of current. One ampere-hour is the amount of current which would flow at the rate of 1 ampere in 1 hour. It is by this unit that the capacity of storage batteries is measured. A 60 ampere hour battery will give current at the rate of 60 amperes for 1 hour, or at the rate of 30 amperes for 2 hours, or at the rate of 1 ampere for 60 hours, etc. Electric current can be of two kinds; direct or alternating. Direct current always flows in one direction in the wire, and is the kind of current which is given out by every type of battery. Alternating current, however, first flows in one direction and then in the other, the reversals taking place many times per second. It is the kind of current given out by most of the modern magnetos.

B. Application of Electricity to Motorcycle Engine Ignition.—Ignition is the firing of the compressed explosive mixture in the combustion chamber of a motor. The firing is done by a spark or stream of sparks passing or jumping between the points of a spark plug. When the spark passes at the plug, the gas surrounding the points is instantly ignited, and the resulting flame shoots

through the entire charge of explosive mixture. The charge explodes, driving the piston downward and the burning of the mixture continues until the exhaust valve is opened. Then the exhaust gases shoot out through the exhaust pipe and muffler to outer air.

Electric current for ignition must be of sufficiently high pressure (voltage) to have the sparks jump across the gap between the plug points, especially when the pressure in the cylinder is from 50 to 60 pounds above atmosphere (the compression pressure). The quantity of current necessary to ignite the charge is very small; hence, a current of high voltage and minute amperage is used. Such a current is called a high tension current.

C. Magnetos.—The high tension current is generated in a special instrument known as a magneto. This instrument has certain parts (the magnets) which have been magnetized, a specially-wound coil, and a rotating member called the armature. The ignition current is developed in the magneto by induction.

A horseshoe magnet has an invisible "field" between and surrounding its poles or ends. The presence of this field can be demonstrated by laying a sheet of paper over the ends of a toy magnet and sifting iron filings on the paper. The iron filings will arrange themselves in a series of curves between the poles of the magnet, thus forming the field. The curves are known as lines of force.

If a coil of wire is rotated in the field between the poles of a magnet and the ends of the coil brought close together, a faint spark will pass between the ends of the coil. This shows that an electric current is flowing along the wire. This current was induced by rotating the wire and cutting lines of force. The influence by which this current was produced in the coil of wire is called "induction."

In a magneto, the coil of wire just referred to consists of a number of turns of insulated coarse copper wire. This wire is wound on an iron core which serves as a support for the coil and also as a sort of concentrator for the lines of force in the magnetic field. One end of the coil is grounded on the frame of the magneto. The other end is attached to one of the points of the contact breaker. The other point of the contact breaker is in electrical connection with the armature shaft through the contact breaker lever.

This coil is known as the primary winding and with the contact breaker forms the primary circuit. Unless the contact breaker points are separated the circuit is complete.

The current produced in the primary winding is not powerful enough to pass between the points of the spark plug. It is a low tension current; one with a low voltage (or pressure) and a great rate of flow (or amperage). To get a high tension current, we have recourse to another form of induction.

If one coil of wire is wound around another coil and an electric current passes through one of the coils, it will induce a current in the other coil when the flow of current in the first coil is interrupted. The voltage and amperage in the second coil depend upon the relation of the number of turns in the first coil to those in the second coil. In a magneto, there are a great number of turns of fine wire wound over the fewer turns of coarser wire in the primary winding. In this second or outer coil is induced the high tension or ignition current.

This second coil is called the secondary winding. One end is grounded on the frame of the magneto, while the other is connected to a collecting device on the armature shaft. Carbon brushes pass the current from this collecting device to the spark plug cables and it travels over these to the spark plugs.

The shell of each spark plug is grounded on the motor, and the return portion of the "secondary circuit" is through the frame of the motor and motorcycle to the magneto.

The primary circuit is continuous or closed except when the points of the contact breaker are separated. The secondary circuit has a permanent gap in it; this being the gap between the points of the spark plug. If the magneto armature is rotated and the primary circuit is interrupted (by separating the contact breaker paints) a high tension current will be induced in the secondary winding and the current will pass at the spark plug. By mechanically separating the contact breaker points at the proper instant, the spark passes at the plug and ignites the compressed charge of explosive mixture in the cylinder at the correct time.

The armature is the rotating part of the magneto. On some makes of magneto it carries the primary and secondary windings which revolve with it. The armature carries cams which act on the contact breaker lever and cause the points to separate at the proper instant to pass a spark at the spark plug. It also carries the collector spool by which the high tension current passes to the brushes and cables to the spark plugs. It is driven by gearing from the motor, at one-half motor speed, to insure the sparks passing at the proper time for each cylinder.

The Dixie Magneto

The armature shaft carries two pieces of magnetic material formed with wings and separated by a non-magnetic centre piece. This construction forms the rotating poles for the magnets and revolves in a field structure composed of thin layers of "laminations" of iron, riveted between non-magnetic rings. The bearings for the rotating poles are mounted in steel plates, close to which are the horseshoe-shaped magnets.

Between the upright ends of the field pieces the coil is attached. This coil consists of a primary and secondary winding. One end of the primary and the secondary wiring is grounded on the magneto at the field structure. The other end of the primary winding passes to an insulated screw on the contact breaker and is electrically connected to the stationary platinum point. The other end of the secondary winding has a carbon brush by means of which the current is taken off and sent to a second brush. The current is led from this second brush to a collector spool and from thence through a brush to the spark plug cable.

The field structure and coil can be rocked through a small arc to vary the timing of the spark. The contact maker casing moves in unison with the field structure and coil.

The armature carries a collar with two cam surfaces on the end of its shaft. These cam surfaces operate the contact breaker lever at the correct instant for each cylinder. The collector spool is mounted near the drive end of the armature shaft in a housing which carries the brush holders to which the spark plug cables are attached.

The contact breaker lever is grounded through the frame of the magneto. Attached to the insulated piece carrying the stationary platinum point is one pole of a condenser. The other pole of the condenser is grounded through the contact breaker casing and frame of the magneto.

The function of the condenser is to absorb the sudden rush of current produced by separating the contact breaker platinum points. If there were no condenser, this current would destroy the points, by reason of the intensely

hot arc which would form between them as they separate. The arc, if allowed to form, would make a path for the current. It is necessary for the primary circuit to be quickly and positively broken in order to get the best effect from the secondary circuit; hence the need of the condenser.

The condenser is made up of a series of small mica and tin foil sheets alternated to form a packet. The tin foil sheets are connected to one part of the primary circuit, while the mica sheets are grounded. The combination of these two materials is effective in absorbing the rush of primary current.

On the Dixie magneto, although the coil is not mounted on the armature, the current is generated in the manner described above.

The current reaches its maximum intensity twice in each revolution of the armature. Each position of the rotating armature giving the maximum intensity is at the instant that the heel of the wing or broad part leaves the field piece. If the armature is observed endwise when the wings are horizontal it will have the general form of the Letter H. On rotating it till the wings come to a vertical position it will resemble the letter I. It is just after assuming the vertical I position that maximum intensity is obtained.

As there are two field pieces and two wings on the armature there will be two I positions per revolution of the magneto; hence there will be two positions of maximum intensity. At these positions, the cam surfaces on the armature shaft act on the contact breaker lever and separate the platinum points.

During the rotation of the armature from the I position through the H position, a current has been induced in the primary winding and in its turn the primary current has started a current in the secondary winding by induction. As the armature rotates toward the I position, the current in the primary becomes stronger until the point of maximum intensity is reached. Instantly, the contact breaker lever is moved by the cam surface. The points separate; the primary circuit is broken and the full power of the high tension or secondary current passes along its circuit, jumping between the points of the spark plug and igniting the explosive mixture in the cylinder. The arc which tends to form between the platinum points is absorbed by the condenser. The cam surfaces on the armature shaft are so arranged in relation to each other that they correspond to the difference in firing interval between the two cylinders of the motor.

D. Electrical Timing.—In the chapter on the Motor it was stated that the full four strokes of the cycle were completed in two revolutions of the fly-wheel. This referred to each cylinder. The cylinders are 42 degrees apart. If we consider the rear or No. 1 cylinder at 0 degrees the fly-wheel will make one revolution before the piston in No. 2 cylinder (the front one) completes its compression stroke. It will take 42 degrees rotation of the fly-wheel *beyond* this point to bring the piston of No. 2 cylinder ready for the firing (passing of the spark). The fly-wheel will then have moved through 360 degrees plus 42 degrees or 402 degrees before No. 2 cylinder commences the explosion stroke.

Between the firing of No. 2 cylinder and No. 1 cylinder again, there will be one revolution (360 degrees) of the fly-wheel less the 42 degrees of angle between the two cylinders. This means that No. 1 cylinder will fire 318 degrees of rotation of the fly-wheel after No. 2 has fired. It will be seen that the firing interval between the two cylinders is unequal and the cams on the magneto are arranged accordingly.

The magneto rotates at one-half speed of the motor and the armature makes one revolution while the motor fly-wheel makes two revolutions. Looking at cam No. 1 on the armature shaft it will be noted that the distance between it and No. 2 cam around the shaft in the direction of rotation of the armature

is greater than the distance between No. 2 cam and No. 1 in the same direction. The actual distance No. 1 to No. 2 is 201 degrees, while between No. 2 and No. 1 it is 159 degrees.

As the motor speed increases, the position of maximum intensity in the magneto changes. There will be a greater gap between the heel of the armature wing and the field piece and the armature will approach the H position again. Unless some alteration is made in the relative positions of the armature wing and the field piece, the spark will occur late—after the position has passed the dead center.

In the Dixie magneto, the field poles with the winding are movable around the armature in an arc. The movement of this structure of the magneto corresponds to the movement of the contact breaker casing. To the latter is pivoted the contact breaker arm. Consequently, the field structure and contact breaker casing can be removed to such a point as will always have the spark occur at the proper instant and with maximum intensity of current. Before suspecting the magneto, when ignition troubles occur, test the spark plugs and cables to see if they are carrying the electric current properly.

If the fault is not found in the plugs or cables and it is electrical, it lies in the magneto.

E. Spark Plugs, Design and Application.—The spark plug is a simple device which consists of two terminals called electrodes carried in a suitable shell member which is screwed into the cylinder. The secondary wire from the distributing device is attached to a terminal at the top of a central electrode member, which is supported in a bushing of some form of insulating material, preferably porcelain, sometimes mica. The insulating bushing and central electrode is housed in a steel body which is provided with a threaded portion on the bottom end of the shell by which it is screwed into the combustion chamber. When porcelain is used as an insulating material, it is kept from direct contact with the metal portion by some form of dialectric material, usually asbestos. This is necessary because the steel shell and the porcelain core have different coefficients of expansion and some flexibility must be provided at the points to permit the materials to expand differently when heated.

The steel body of the plug which is screwed into the cylinder is in metallic contact with it and carries one of the electrodes which forms one of the points in the air gap over which the spark occurs. The porcelain is glazed so that it will not absorb oil and it is subjected to much higher temperatures in baking so that it is not liable to crack when heated. Spark plugs may be screwed into any convenient part of the combustion chamber, the general practice being to install them into the caps over the inlet chamber so the spark will be directly in the path of the entering gases from the carburetor. When the electrodes are carried in a pocket type plug, they are more liable to become short circuited by oil or carbon accumulations because it is difficult for the fresh gases to reach them and the pocket tends to retain the heat. There are three standard types of spark plugs, namely, the standard ½ inch, the metric and the seven eighteen S. A. E.

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EXERCISE VII

TROUBLE CHART

(*a*) Various troubles of Engine, Bearings, Carburetors, Ignition Systems.

MAGNETO.

Circuit breaker points out of adjustment.
Circuit breaker points pitted.
Circuit breaker points worn badly.
Brushes oil soaked.
Brushes worn.
Magneto water soaked.
Magneto faulty.
Cables faulty.

NO SPARK.

Cracked core.
Points set wrong.

SPARK PLUGS.

Electrodes oxidized.
Oil soaked
Sooted.

TIMED WRONG.

Were gears removed?
No key in pinion.
No key in generator gear.
No key in magneto gear.

CARBURETOR TROUBLE.

No gasoline.
Water in gasoline.
Gasoline tank clogged.
Sediment in carburetor.
Carburetor out of adjustment.
Carburetor out of order.

GOOD SPARK.

Valves Do Not Seat.

Poor lifter pin and pushrod adjustment.
Valves stem bent, seat warped.
Seats pitted.
Valve key sheared off.
Valve spring broken.
Lift mechanism sticks.

Valves Do Not Lift.

Roller arms broken.
Lifter pins and pushrod loose.
Pinion gears sheared.
Gears stripped.

NO COMPRESSION.

Valves Timed Wrong.

Were gears removed?
No key in pinion.
Were any new gears fitted?

Valves Seat O/K.
Motor worn from service.
Cylinders scored.
Piston rings worn.
Piston rings burnt—no life.
Sand hole in piston.
Inlet housing clamped loosely.
Inlet housing warped.

(*b*) Removal of causes of trouble.

1. A chart included with this lecture outlines the various motor conditions with which it will be found necessary to control. Motor troubles may be subdivided under the following heads:

(*a*) Motor does not run.

(*b*) Motor misses.

(*c*) Motor starts with difficulty.

(*d*) Motor stops shortly after it is started.

(2) Motor does not run. The first inspection must develop one of these three conditions.

(*a*) No spark.

(*b*) Defective spark plug.

(*c*) Good spark; motor does not start.

3. No spark. If no spark is developed at the spark plug and it is not possible to feel a distinct electric shock when the hand is held on the plug and the motor moved, the trouble lies in the magneto. Be absolutely sure that this is the case before proceeding further. Magneto repairs should be performed only by the mechanic; never by the rider. The points to cover are as follows and, if these adjustments fail to rectify the trouble the magneto must be sent to the shop for repairs.

(*a*) Circuit breaker points out of adjustment. The proper distance between the platinum contact points when fully separated should be .020 inch. A gauge of the proper thickness is provided upon the special magneto wrench for measuring this adjustment. If the distance is more or less than this correct the adjustment; then try to start the motor. Be sure the adjustment is correct for both cylinders.

(*b*) Circuit breaker points pitted. The platinum contacts should be kept clean and properly adjusted. Should the points become pitted, they may be smoothed by the use of a very fine jeweler's file in order to permit them to come into perfect contact. Be sure the field surfaces are parallel, and readjust them after filing.

(*c*) Brushes oil soaked. Remove the spring or screws, as the case may be, and remove the brush holder. Care must be taken not to damage the rubber gasket. Clean the brush and holder with gasoline and remove all oil from the collector spool.

(*e*) Collector spool oil soaked. Remove the brush holders, dip a piece of cloth in gasoline, wrap it around a lead pencil, and insert it in the brush hole. Rotate the magneto by turning the motor over slowly and carefully a few times so as not to injure the collector spool as it is very delicate. Grease and dirt may be removed by forcing a gunful of gasoline through the spool housing opening. Blow out the gasoline with a tire pump before restarting.

(*f*) Brush holder cracked. Examine these closely for small cracks through which the electric current may escape. Sometimes these cracks are hard to find. If the brush holder is of hard rubber, cracks may be detected by smell-

ing the rubber after running the motor on the one good cylinder. Defective holders must be replaced by new ones.

(*g*) Brushes worn. The carbon brushes may be free to move and project one-quarter inch from the end of the brush holder. If found to be worn, they must be replaced.

(*h*) Magneto watersoaked. The only remedy is to dismantle the instrument, thoroughly dry the coils and windings, and reassemble it. This work must be done only in the shop.

(*i*) Faulty cables. A bruised or burnt cable is apt to follow the current to leak so as to ground and to cause an occasional miss in the motor. This can be detected by running the machine in a dark room and observing the spark jump to some part of the frame. Temporary repair may be made by use of tape, but the cable must be replaced as soon as possible.

(*j*) Faulty magneto. If the magneto does not generate current and none of the foregoing troubles are located the magneto must be sent to the shop for general repairs.

(*k*) Faulty spark plugs. If the spark plug is defective, it may be caused by:

1. Cracked core. Replace core.

2. Points set improperly. The space between the spark plug points should be .020 inch. A gauge is provided for making this adjustment.

3. Electrodes oxidized. Clean the points with emery cloth and test. If the plug fails, replace with a new one.

4. Plug oil soaked. Take the plug apart, wrap a small strip of sand-paper or emery cloth around the core, and revolve the core several times with the fingers. Be sure to make the electrode tight so that it will not leak compression.

5. Sooty plug. Clean with gasoline and emery cloth. Good spark; Motor does not start. If the spark plugs are in good condition and there is a good spark at each cylinder, trouble may be traced further.

1. Motor timed incorrectly.

2. Carburetor.

3. No compression.

Motor timed incorrectly;

(*a*) Timing gears changed; if the gears have been removed for any reason, it is possible that they have been incorrectly replaced. Inspect for this fault.

(*b*) No key in main drive pinion. The key may be sheared or broken. Replace it by a new one.

(*c*) No key in magneto gear. The key may be sheared. Be sure that all timing marks on the gears line up, and that the breaker is timed to cause a spark in the proper cylinder at the proper time. When the breaker box is in the fully advanced position, the points should separate about 11/32 inch before the piston reaches the top center on the compression stroke. Accurate timing cannot be made outside of the shop. The cylinders are numbered 1 and 2. Be sure that the spark is timed with the breaker arm resting upon the breaker actuating cam for the particular cylinder under inspection. One cylinder being correctly timed, it is evident that the other must follow in exact relation, unless the mechanism is out of order. Check up on both cylinders before passing the work out as finished.

Carburetor trouble: First examine all conditions of the gasoline supply system outside of the carburetor.

(*a*) No gasoline; examine the main gasoline supply tank to see whether the valve is open; examine the reserve tank.

(*b*) Water in gasoline: This condition usually causes the motor to run erratically with frequent misfiring. To remedy, it is necessary to dismantle the carburetor, remove the bowl, remove the gasoline line and completely drain the tanks.

(*c*) Gasoline Tank Clogged: If a large amount of dirt or sediment has collected in the tank, it is necessary to remove and thoroughly wash it out with clean gasoline, draining it through the large filler cap openings.

(*d*) Gasoline Pipe Clogged: Remove the pipe and blow it out with air pressure.

(*e*) Sediment in Carburetor: Remove the carburetor bowl and wash it out with clean gasoline. Blow out any deposit in the jet before reassembling.

(*f*) Carburetor out of Adjustment: Follow the instructions under the chapter on carburetors.

No compression:

(*a*) Valves do not seat: Poor lifter pin or push rod adjustment. One of these members may be broken and be the cause of a valve being held open. Raise the valve spring covers and by means of a thickness gauge. Be sure that there is between .006 and .008 inch clearance between the tappet and the end of the valve stem when the motor is cold. If there is less than this it causes trouble on account of the expansion of the valve stem as the motor heats. If greater than this, it tends to destroy the correctness of the timing and to decrease the valve opening. The overhead intake valve adjustment should be made with a cold motor, allowing about .004 inch between the end of the valve stem and the rock arm. Care should be taken that the cam is in such a position that the valve is fully closed before making any adjustments.

(*b*) Valve Stem Bent. Seat Warped. Care must be used in removing valve springs not to bend the valve stems. If they are bent, they should be replaced by new ones. If the seat is warped, the valve should be reground. (See next paragraph.) Always grind in a new valve to its seat.

(*c*) Seats Pitted. If the valves are pitted and cause a loss of compression they must be reground. The motor should be taken from the frame and the cylinders removed for this operation. Before the grinding in of a valve the seat should be refaced with a reamer. Pitting of the valve seat is caused by a poorly fitted valve and seat surface. A pitted seat should not be reground with a valve grinding compound for the following reasons:

(1) Excessive grinding is necessary to remove the pits in the cylinder and from the seat.

(2) The valve being considerably harder than the cylinder seat becomes lower after much grinding. This allows the valve to seat deeper in the wall chamber. As a result the clearance between the valve and the cylinder when the valve is in the raised position is reduced. Also the motor is not properly scavenged and loads up with burnt gases. By the use of a reamer, a minimum of stock is removed.

3. Excessive grinding or lapping ruins the straight face of the valve and cylinder seat and allows only a very narrow seat.

(*d*) Valve Key Sheared Off. If the valve cover is raised, this trouble may be ascertained by inspection. Remove the spark plug and insert a tool to hold the valve to its seat. Raise the spring and collar into place and insert a new valve spring collar key.

(*e*) Valve or Cylinder Seat Cracked. Replacement.

(*f*) Valve Spring Broken. Raise the valve sleeve and the valve and remove the old spring. Replace it with a new spring.

(*g*) Lift Mechanism Sticks. Raising the valve cover shows whether the valve is operating. Sometimes the valve sticks in the guide owing to gummy oil. Cleaning with gasoline may serve to remove the trouble.

Valves do not lift. There may be four causes for this.

(*a*) Roller or Lifter Arm Broken. Remove the timing gear case cover and examine the members. If broken, replace them with new ones. It will be necessary to remove the cam also; but it must be replaced according to instruction.

(*b*) Lifter Pins and Pushrods Loose. Sometimes the lock nut on the lifter pin adjustment may work loose and allow the adjustment to recede so far that the valve is not opened.

(*c*) Pinion Gear Sheared. The motor has to be entirely retained if this condition obtains.

(*d*) Timing Gears Stripped. They must be replaced and the motor retained.

Valves Timed. Wrong. This may be due to the fact that:

(*a*) Gears were removed.

(*b*) No key was in the pinion.

(*c*) New gears were incorrectly fitted.

If any of the above conditions obtain, a complete retiming of the motor will be necessary. This, of course, refers to the time of opening and closing the valves. These points are designated in two ways; either by degrees or by the piston position measured in inches. The word "cycle" means a series of events in regular order or sequence.

The meaning of the term "four-stroke-cycle" is as follows: A stroke is one-half revolution or 180 degrees of travel of the flywheel. The flywheel must make two revolutions to complete one power cycle of the motor (per cylinder); hence, the term "four-stroke-cycle." The names of the strokes required to complete a cycle are "intake," "compression," "power," and "exhaust." Piston positions are determined for either the upper or lower dead center, in terms of inches measured by a small, graduated steel scale inserted in the plug hole in the top of the cylinder head. As the flywheel of a motorcycle engine is entirely inclosed, it is impracticable to measure degrees of travel on the flywheel. Dead center is the point at the extreme upper or lower end of piston travel just before the piston begins to travel up or down, or the point at which the piston has no motion.

Before starting to time the valves, make all push rod adjustments accurately. They should be as follows:

Harley Davidson—exhaust—.008 inch clearance.
Harley Davidson—intake—.004 inch clearance.
Indian—exhaust—.006 inch clearance.
Indian—intake—.006 inch clearance.

All the above adjustments are with the motor cold. Assuming that the explosion has taken place, it can easily be understood that there must be an outlet at the proper time to get the full benefit of the energy obtained by the explosion, and to prevent possible injury to the motor. This point of exhaust opening is between ¾ inch and 9/16 inch before bottom dead center. The exhaust valve opens in this position and closes when the piston is 1/32 inch

to 3/32 inch past top dead center. Since the inlet cam is mounted on the same gear with the exhaust valve cam they do not require independent timing. After the inlet valve closes, the charge is compressed; otherwise complete combustion would be very slow and little power or speed produced. In this connection the importance of having the valve seats properly adjusted can be appreciated. A poorly seated valve lets a great amount of compression leak by.

Where the charge is properly compressed it must be ignited. On the twin cylinder magneto machine the spark should occur ¼ inch to 5/16 inch before top dead center or the compression stroke, with the interrupter housing in fully advanced position. Theoretically the proper time for exploding the charge is at top dead center on the compression stroke when the charge is compressed as much as it can be. There is, however, a slight lapse between the sparking and the explosion. When the spark occurs, it first ignites the charge around the spark plug points. This flame then spreads through the rest of the mixture, forcing the piston downward. The time between the spark and the complete explosion of the mixture is very short; but it can easily be understood that as the speed of the motor increases, the spark should be advanced. For this reason the time of ignition is made adjustable with the use of the left grip.

If the motor is run at high speed with a retarded spark, the spark occurs when the piston is 1/16 inch to ⅛ inch past top center on the power stroke. Considerable energy is lost on account of the lapse of time between the spark and the complete explosion. Then again, running the motor at slow speed with fully advanced spark results in injury to the motor in time, because complete combustion of the charge takes place before the piston has reached dead top center on the compression stroke. The effects of this can more easily be noticed in the form of a knock when one is driving at low motor speed with open throttle on a hard pull.

Therefore, to get the full effect of the explosion, the spark should occur slightly before top center on the compression stroke. Place the motor in such a position that the piston is ¼ inch to 5/16 inch before top dead center on the compression stroke. To do this, revolve the motor in the direction of rotation to top center and then reverse to the proper position. Cam No. 2 times the ignition for the front cylinder; cam No. 1 for the rear. If cylinder No. 2 is in the correct position, revolve the armature of the magneto by means of the gear on the tapered end of the shaft until cam No. 2 just starts to break the platinum point. Then drop the idle gear into place. Check the timing on the other cylinder in the same way, to be sure it is correct.

Motorcycle motors are also fitted with a rotary valve to relieve crank case compression. The part in the sleeve of the relief valve must be open from 1/16 to 3/32 of an inch when the front piston is on top dead center. This part opens gradually when the motor is turned in the direction it runs, and closes when the piston has reached bottom dead center. If the motor used still has its original timing gears, they are found to be marked. For convenience in roadside timing they are accurate enough and handy. When on the bench the timing, if set by marks, should be checked over by seals as described in previous paragraphs.

If there is no compression and the valves seat O/K. there are several conditions that may hold true:

(*a*) Motor Worn From Service. The motor must be entirely disassembled, inspected, and reassembled. All worn parts are to be replaced in the process. (See the lecture on Shop Work on Motor Assembly.)

(*b*) Cylinder Scored. Such cylinders must be replaced by new ones. Cylinder can be sent to the manufacturer for regrinding or must be scraped. Motorcycle cylinders are taper ground, and a satisfactory job cannot be done outside of the factory.

(*c*) Piston Rings Worn. If the ring is worn in its groove in the piston or at its lap ends, it should be replaced. When the new ring is fitted, it must fit the piston groove snugly, but also be free to move in the groove. If it binds, correct this trouble before assembling, by rubbing the ring upon a piece of emery cloth tacked on a flat board. In the fitting of the lap ends of the ring it should be inserted in the cylinder without the piston. There should be 0.20 inch opening at the end of ring to allow for expansion.

(*d*) Piston Rings Burnt—No Life. Replace them, following the instructions in previous paragraph.

(*e*) Piston Rings Fit too Loose. Replace them, following the instructions in paragraph (*c*).

(*f*) Sand Hole in Piston. This trouble is more prevalent in new motors than in old, and is sometimes very hard to locate. It is a casting flaw which has shown up in service. The only remedy is to replace the piston with a new one. Sometimes the hole is in the bottom of a ring groove under a ring. Then it is very hard to locate. This is an uncommon trouble, however.

(*g*) Sand Hole in Cylinder. This can easily be detected by glass blowing out when the motor is running; it is most likely to be found in new motors. The only remedy is to replace the cylinder.

(*h*) Inlet Housing Valve Plug Loose. Tighten the offending member until it does not leak. In the case of the intake valve housing it may be necessary to grind in the seat of the housing in the cylinder to make it gas tight.

(*i*) Inlet Housing Warped. The housing should be inserted in a lathe and a small cut taken off the seat and shoulder. Then regrind it into the cylinder so that it is tight. If it still leaks, replace it with a new housing.

The above disposes of all cases coming under the heading "Motor Does Not Run." Sometimes a motor misses explosions upon one cylinder or the other. The next outline covers these cases.

CHART TO TRACE AND CORRECT TROUBLE

PLUGS SPARK REGULARLY.

Carburetor at Fault.
- Readjustment carburetor.
- Water in gasoline.
- Poor gasoline.
- Gasoline line clogged up.
- Sticking needle valve lift lever.
- Auxiliary air valve loose on bushing.
- Auxiliary air valve spring worn.

Poor Compression.
- Valves do not seat.
- Lifter pins adjusted improperly.
- Push rods adjusted improperly.

Air Leaks—Test with Gasoline while Motor is Running.
- Around inlet housing.
- Around manifold nuts and nipples.
- Around spark plugs.
- Around cylinder plugs.
- Around priming cocks.

MOTOR MISSES.

At All Speeds.
- Faulty spark plugs.

Dirty gasoline or clogged line.
Poorly adjusted carburetor.
Poor compression.
Sticking valves.
Valve key sheared off.
Readjustment carburetor.
Faulty Spark Plug.

At Low Speed.

Poor Compression
- Poor lifter pin adjustment.
- Poor push rod adjustment.
- Valves do not seat.
- Leaks past piston rings.
- Sand hole in piston or cylinder.

Air Leaks—Test with Gasoline while Motor is Running
- Around inlet housing.
- Around manifold and nipples.
- Around spark plugs.
- Around cylinder plugs.
- Around priming cocks.

At High Speed.

Faulty Spark Plug.
Dirty gasoline or clogged line.
Readjust Carburetor.
Weak valve springs.
Sticking lift mechanism.
Sticking valves.
Sticking circuit breaker lever.

PLUGS SPARK IRREGULARLY.

Magneto
- Faulty spark plug.
- Sticking circuit breaker lever.
- Brushes and distributor spool oil soaked.
- Oil on circuit breaker points.
- Pitted circuit breaker points.
- Poorly adjusted breaker points.
- Bruised spark plug cables, causing short circuit.

Motor Misses. There are five conditions to examine to determine under which head the trouble lies:

(*a*) Plugs Spark Regularly.

(*b*) Motor Misses at All Speeds.

(*c*) Motor Misses at Low Speed Only.

(*d*) Motor Misses at High Speed Only.

(*e*) Plugs Spark Irregularly.

If the Plugs Spark Regularly and the Motor Misses, the trouble is due to one of three reasons:

(*a*) Carburetor at Fault:

(1) Readjust Carburetor. See instructions in chapter on "Carburetors and Vaporizers."

(2) Water in Gasoline. See previous instructions.

(3) Poor Gasoline. Sometimes gasoline of very poor quality is obtained that does not vaporize in a cold motor. Drain the tanks and replenish them with fresh fuel.

(4) Gasoline Line Clogged. Covered in previous instructions.

(5) Auxiliary Air Valve Loose on Bushing. This allows superfluous air to leak into the carburetor, causing a lean mixture at low speed and irregular running. Replace with a new air valve.

(6) Auxiliary Air Valve Spring Worn. This also causes a weak mixture. Replace it with a new spring.

(*b*) Poor Compression:

(1) Valves do not Seat. See previous instructions.

(2) Lifter Pins Improperly Adjusted. See previous instructions.

(3) Push Rods Improperly Adjusted. See previous instructions.

(*c*) Air Leaks. These may occur at several places in the cylinder system where they upset the mixture for one or both cylinders and cause uneven running. These points are:

(1) Around inlet housing or valve plugs.

(2) Around inlet manifold, nuts and nipples.

(3) Around Spark Plugs.

(4) Around Cylinder Plugs.

(5) Around Priming Cocks.

To test; take a gasoline squirt gun from the tank and shoot some gasoline on the suspected members while the motor is running. When the offending member is located, that cylinder is found to slow up considerably from the rich mixture. If continued, it may become too rich and stop. Tighten the loose part and retest until all points are tight.

Motor Misses at All Speeds. This is due to the following causes, a correction for which has previously been given:

(*a*) Faulty spark plugs.

(*b*) Dirty Gasoline or clogged line.

(*c*) Poor carburetor adjustment.

(*d*) Poor compression.

(*e*) Sticking valves.

(*f*) Valve key sheared off.

Motor Misses at Low Speed. All of the conditions under this head in the outline are also covered previously. Their application will rectify the trouble.

Motor Misses at High Speed. This is due to one of the following causes:

(*a*) Faulty Spark Plug. See previous instructions.

(*b*) Dirty Gasoline or clogged line. See previous instructions.

(*c*) Readjust Carburetor. See carburetor lecture.

(*d*) Weak Valve Springs. These are hard to detect; but it is impossible to do so by raising the valve cap. Speed up the motor and exert additional pressure by inserting a screw driver in the valve spring and by pressing in the direction in which it exerts its pressure. This should correct the miss. If it does not, remove the old spring and insert a new one.

(*e*) Sticky Lift Mechanism. See previous instructions.

(*f*) Sticky Valves. See previous instructions.

(*g*) Sticky Circuit Breaker Lever. Remove the cover of the interrupter housing on the magneto and see whether the fiber bushing of the breaker arm is swollen or stuck. If it is, remove the arm and ream out the bushing slightly. Be sure that it operates freely, as this is sometimes the most elusive cause of a high speed miss. Be sure also that the breaker spring is intact and exerts sufficient pressure.

Motor Misses—Plugs Spark Irregularly. The fault undoubtedly lies with the magneto, plugs, or cables. The treatment for all of these conditions has been given previously.

(*a*) Faulty Spark Plug.

(*b*) Sticking Circuit Breaker Lever.

(*c*) Brushes and Distributor Spool Oil Soaked.

(*d*) Oil on Circuit Breaker Points.

(*e*) Pitted Circuit Breaker Points.

(*f*) Poorly Adjusted Circuit Breaker Points.

(*g*) Bruised Cable Causing Short Circuit.

Motor Stops Shortly After It Is Started. All conditions under this head are due to one of six causes:

CHART TO TRACE AND CORRECT TROUBLE

MOTOR STARTS HARD.

Good Spark.

Poorly adjusted carburetor.
Water in gasoline.
Poor gasoline.
Poor compression.

Magneto.

Plug points set wrong.
Plugs faulty.
Poorly adjusted or pitted circuit breaker points.

Poor Spark.

Dirty distributor spool.
Dirty brushes.
Sticking circuit lever.
Magneto at fault.

CHART TO TRACE AND CORRECT TROUBLE

MOTOR STOPS SHORTLY AFTER IT IS STARTED.

Magneto.

No gasoline.
Gasoline pipe clogged.
Poorly adjusted carburetor.
Carburetor at fault.
Float set too low.
Motor runs tight.

(*a*) No Gasoline. Examine tanks.

(*b*) Gasoline Line Clogged. See previous instructions.

(*c*) Poorly Adjusted Carburetor. See Carburetor Lecture.

(*d*) Carburetor Defective. Replace same.

(*e*) Float Set Too Low. This condition maintains too low a gas level in the carburetor bowl and causes a low level at the gasoline nozzle. The carburetor should be dismounted and the float bowl removed. Now bend the float arm carefully so that the float valve is in a higher position before the float valve shuts off the gasoline. A very little is found to be sufficient. Reassemble and retest.

(*f*) Motor Runs Tight. Undoubtedly this is due to a lack of lubrication, a broken motor internal part, or too tight bearings. To reassemble see the shop lecture on "Motor Assembly."

MOTOR KNOCKS.

Poor carburetor adjustment.
Lack of oil.
Poor oil.
Overheating.
Overloading.
Spark too far advanced.
Carbon.
Loose bearings.
Loose pistons.
Defective spark plugs.
Piston out of aiignment.

Motor Knocks. This is due to the following causes:

(*a*) Poor Carburetor Adjustment. A mixture too lean or too rich causes a knock. Readjust the carburetor.

(*b*) Lack of Oil. This causes overheating. Force some oil into the crank case with the hand pump.

(*c*) Poor Oil. Improper oil is being used. See the lecture on "Lubricants and Lubricating."

(*d*) Overheating. This is caused by any of the above conditions and sometimes occurs after a long hard run in low gear.

(*e*) Overloading. Asking the motor to do impossible things. Use the low gear; and if it does not pull out, then assist by pushing the vehicle.

(*f*) Spark Too Far Advanced. See previous timing instructions. Retard the spark under heavy pull.

(*g*) Carbon Deposit in Motor. Such deposits are caused by burned oil. Cylinder should be removed, the carbon scraped out, the valves reground. *Never burn carbon out of a motorcycle motor by the oxygen process. A ruined motor will be the result.*

(*h*) Loose Bearings. The motor should be overhauled.

(*i*) Loose Pistons. The motor should be overhauled.

(*j*) Defective Spark Plugs. The points become incandescent, causing premature ignition. Replace them with new ones.

(*k*) Pistons Out of Round or Out of Line. Remove the cylinders and true them up as per instructions in the lecture on "Motor Assembly."

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LABORATORY

EXERCISE VIII

TRANSMISSION, CLUTCH AND STARTER

The gear set of the military motorcycle comprises three very important units:

1. Transmission.
2. Clutch.
3. Starter Mechanism.

This complete unit receives the power from the motor by means of a roller chain. The power is then transmitted over a second set of sprockets to the rear wheel by another roller chain.

The transmission is mounted upon a sliding track in such a manner that it may be moved bodily to permit adjusting for the wear and stretch of the chain connecting it with the motor sprocket. This, of course, loosens the rear drive chain also. Sliding the rear wheel back in its forks takes care of the adjustment of the main drive chain.

All military motorcycles are equipped with this three-speed progressive type transmission. After a general description of this unit, detailed instructions for the care and adjustment of the two most prevalent makes will be given.

This transmission affords three forward speeds, progressively operated but not reverse, since the latter is unnecessary in a motorcycle. It has a sliding set of two points, which also carry the jaws for the direct drive clutch. This gear slides on the spline shaft. The three gears on the counter shaft are made in single pieces, which revolve on the stationary counter shaft.

Upon all motorcycle transmissions a device is provided to make it impossible to shift gears without first entirely releasing the clutch. This eliminates the chance of stripping gears by inexperienced drivers.

The starter mechanism is also shown in the drawing. It consists of a long lever provided with a pedal which operates downward and toward the rear of the machine. By means of a special ratchet device which engages automatically, when pressure is applied to the lever, it is possible to revolve the motor for purposes of starting. Upon all machines the gear level must be in the neutral position and the clutch fully engaged to perform this operation properly.

Sometimes when pressure is applied, the gears of this apparatus do not properly mesh. Upon the Harley-Davidson machine a special device is provided which enables the rider to readjust these gears momentarily into their proper relation for meshing.

In ordinary service the only care or attention the three-speed transmission requires is that the proper oil level be maintained.

Use No Grease
Use No Graphite Lubricants

The proper lubricant is the same grade of oil used in the motor. Inspect transmission oil every 500 miles or, say once a week. Keep the level up to the top of the filler opening and be sure the machine is standing level when the case is filled. Oil should be put in slowly, as it takes time to reach all parts of the transmission.

There are several small oilers provided for lubricating the shifting device, clutch rods, etc. These members should be taken care of with a drop of oil every day or so. A nice, smooth, easy working control is essential.

Too much emphasis cannot be laid on the fact that liquid oil only should be used in the lubrication of the three-speed transmission. Hard oil or grease should never be used. To disregard these instructions results in serious and costly transmission trouble.

Transmissions

First, the neutral position inside the gear box must be determined. This can be accomplished in the following manner: First, place the hand shifting lever in the neutral position, then disconnect the rod which connects the lever to the gear box. Then push the hand clutch lever forward in order to disengage the outside locking device latch. Then move the notched lever on the outside of the gear box up and down slowly to determine the exact position where the spring plunger properly seats in the "V" notch on the shifting rack inside of the gear box. Then pull the clutch hand lever back to determine whether the locking device latch properly engages in the neutral notch on the locking device.

If this is found to be out of adjustment, it can be either raised or lowered as necessary, by means of the eccentric stud which forms a bearing for this latch. Then adjust the long rod from the gear box to the shifting lever so that the stud hole in the clevis lines up with the stud hole in the lever.

Always adjust the shifting lever from neutral.

After adjusting chains, always try the gear shift with the power on to see whether it is working properly.

It may be necessary to readjust the long shifting rod after adjusting the chains, as the latter operation necessitates the movement of the gear box. When in the course of time lost motion develops in the shifting mechanism, take up this "play" by means of the adjustment provided, in order to secure a full engagement of the driving cogs on high. If they do not fully engage, they are liable to slip by under a heavy load; and if the corners are chipped off, it is necessary to have a new driving cog fitted. The same applies to the gears.

A screw plug on the right side of the gear box, about half way from the top, is provided for injecting the lubricant into the gear box. Use very heavy oil, preferably steam engine oil. (*Do not use grease.*) Inject the oil with a squirt gun until it runs out from the filling hole. Test the oil supply twice a month by removing the lower drain screw on the right side of the gear case. If the oil does not run out freely inject a fresh supply through the filling hole higher up. *Watch the oil supply carefully to prevent the gears and bearings running dry.* The lower screw plug can be removed to drain the old lubricant before injecting a fresh supply. Be sure to replace the drain plug.

Harley-Davidson Clutch

This clutch is of the dry plate type. The only attention it requires is proper adjustment. It runs on two rows of roller bearings. Between them is a

small channel containing an absorbent material. An oil hole is provided on the outside of the clutch, through which lubricating oil may be squirted into this absorbent ring. This retains the oil upon the surface of the roller journal. Oil inserted here once a week is sufficient.

Adjustment of the Clutch

If it is noticed that clutch is slipping and does not hold properly when pulling hard through sand or mud, or when climbing hills, it should be adjusted. Before turning the clutch adjusting screws make sure that the adjustment of the clutch lever is correct as explained in the next paragraph.

If the clutch lever has no free motion when in the extreme forward position, the clutch may slip; and it is always necessary to see that this adjustment is correct before tightening the adjusting screws. The clutch does not hold even though the adjusting screws are tightened if the adjustment of the clutch lever is not correct. On the other hand, the clutch does not release properly if the hand lever has too much play.

To insure that the clutch holds and releases properly, the lever must have ½ to ¾ inches free motion at the top of the lever when in the extreme forward position. If the clutch slips and it is seen that the adjustment of the clutch lever is correct, it is generally possible to tighten the clutch sufficiently by giving each of the six adjusting screws one half turn to the right. These screws can be reached through a small hole in the chain guard without removing the latter. Care should be taken to see that the six screws are given the same number of turns, regardless of how hard some of them may turn. As mentioned, one half turn each is generally sufficient, but if it does not tighten the clutch enough, a second half turn, making one full turn for each screw, should prove to be enough. These adjusting screws are self-locking; therefore, be sure that each screw drops into its seat after each half turn.

If the clutch lever has no free motion when in the forward position, loosen the nuts on the clutch and pull the rod until this free motion is obtained. One quarter turn makes a big difference. These nuts are reached through the large hole in the middle of the chain guard without removing the guard.

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EXERCISE IX

MAINTENANCE

Aside from the motor, transmission, and clutch, the following parts of the motorcycle require attention at frequent intervals:

1. Handle-bars.
2. Forks.
3. Front wheel.
4. Tanks.
5. Frame.
6. Foot boards.
7. Saddle.
8. Rear wheel.
9. Chains.
10. Brakes.
11. Equipment.
12. Sidecar.

The Handle-bars. The handle-bars of the motorcycle perform the same duties as the steering wheel of the automobile. Careful attention and daily inspection should be made to be sure that the bars are always tightly fastened into the front forks. If any loose nuts and bolts are found they should be immediately tightened.

The twist grip for throttle, spark, and valve lift should be examined and a few drops of oil placed where necessary.

Harley-Davidson Controls. This inspection is performed by removing the nut at the end of the grip. This allows the grip to be removed. This exposes the control wire mechanism and allows for the cleaning and lubrication of the same. This operation should be performed once a week.

Indian Controls. Careful inspection and oiling of universal joints and telescopic sleeves are required. Be sure that all small nuts on control rods are tight. Inspect telescopic sleeves to be sure that they have not been broken by turning the forks too far to one side or by abusive treatment.

Forks. This portion of the machine should be inspected weekly to be sure that it is tight in the frame, i. e., that the head cups and cones of the thrust bearing are properly adjusted. This adjustment is the same on all makes of machines. If play is found, loosen the lock nut at the top of the head, and screw down the cone until the play is entirely taken up. Care must be used not to make this adjustment too tight, or difficulty in steering is experienced. After adjusting, set the lock nut up to the cone so as to hold it in place.

Harley-Davidson Forks. This fork is made in such a manner that the road shocks are absorbed by four springs. There are two main springs which re-

quire inspection only once a year and two rebound springs which may require periodical replacement due to breakage. To replace these springs a special prying bar is inserted between the fork rocker plate studs in such a manner that pushing down on the lever relieves the spring tension upon these rebound springs. The caps at the top of the fork sides may now be removed safely and the broken springs extracted. Never remove these caps unless the tension on the springs is removed.

Disregard of this may be the cause of a serious accident. At the bottom of the forks are found the rocker plates. The fork studs are provided with bushings; and should wear develop, they may be readily replaced. Grease cups are mounted in the plate serving all four stud bushings. These should be filled with grease once a week and screwed down one turn every day.

Indian Fork. Oil the rocker cranks every day and also inspect the fork springs for broken leaves. If any are found to be broken they should be replaced by the mechanic at once. This is readily performed by removing the front mud guard. Then unbolt the old spring and insert the new leaf, or leaves, as may be necessary.

Alignment. Inspect all machines once a week for alignment. Be sure that the forks are not bent, also that the front wheel is in the center of the fork and that it tracks properly with the rear wheel. Bent forks are easily noticed by the tendency of the machine to run continuously to one side or the other of the road.

Front Wheel. Very little difficulty is ordinarily experienced with front wheel spokes. This particular wheel is abnormally strong for the service that it is called upon to perform. Inspection should be made at least once a month, however, to find loose spokes and to tighten them if they are loose. Watch the cones of the front wheel, especially in side car service, that they do not develop lateral play. When this occurs, remove the wheel and make the proper cone adjustments. First ascertain whether the front axle is tight. Sometimes this works loose and allows the wheel to loosen. Tightening the axle properly rectifies this condition. If the cone adjustment is at fault, remove the front wheel entirely from the forks, and loosen the two lock nuts on each side of the front cones. Then readjust the cones so that there is no play and yet so that the axle turns readily in the front hub. Reset the locking device if one is provided, and replace and tighten the lock nuts. After the wheel is replaced in the forks, inspect to see that the adjustment is not too tight. All hubs should be entirely disassembled, cleaned, and repaired with grease every three thousand miles (3000). *Use no graphite grease of any kind.*

Tanks. A weekly inspection should be made of all gasoline and oil tanks. All nuts and bolts should be in place, and tight. To allow the tanks to become loose on the frame soon causes the seams to open and the tanks to leak. If a tank leaks, the machine should be immediately withdrawn from service and reported to the mechanic for repairs. Where tank bolts and screws are doing double duty and are also holding accessories and equipment, particular care must be taken to see that everything is tight.

Frame. All points of the motorcycle frame should be inspected weekly for breakage or cracks. This is especially required in side car service.

Foot Boards. These should be kept tight by the bolts that are provided for that purpose. Also daily inspect and lubricate the clutch and brake operating pedals which are fastened to the foot boards.

Saddle. Inspect the saddle once a week to see that all the nuts are tight and that no springs are broken. It is very annoying to lose saddle parts, as the

threads are usually special and very hard to replace without duplicating the nut or bolt that is lost.

Rear Wheel. This part of the machine is subjected to more abuse, wear, and tear than any other part. Hence its inspection and adjustment should be often and carefully attended to. The instructions given for the adjustment of the front hub will also apply to the rear wheel. Being required to take the tremendous driving strain, the spokes of the rear wheel are very susceptible to loosening and should be daily inspected and loose spokes tightened. When spokes break, the machine should be reported to the mechanic for the purpose of replacing them.

Never use thin lubricant or vaseline in packing the rear hub; such a lubricant in time works past the grease retainers and gets into the break, causing slipping. Never use a graphite grease to pack ball bearings.

Chains. When the chains are properly adjusted they should be fairly tight, that is to say, they must not hang to any appreciable length. On the other hand, they must not be tight, in the strict sense of the word. There should be a little play. It is a common practice among riders to slight this adjustment of chains, but it is a very simple matter to take care of and its execution should be required whenever inspection proves that it is necessary.

The drive chains being of the roller type must be kept well lubricated at all times. Lubrication is very important on account of the number of joints or links in a chain. To neglect a chain means to shorten its life greatly, to cause loss of power and speed besides making the motorcycle extremely noisy. A poorly lubricated chain causes a jerk at low speeds and breaks on the least provocation.

A chain properly lubricated keeps off most of the water in a bad rainstorm or in the fording of a stream. On the other hand, a chain which is not kept well lubricated becomes rusty immediately after getting wet. A rusty chain eventually means a broken chain, because rollers, bushings and rivets rust together, and then is apt to snap.

Very often riders squirt a quantity of oil into the chain from an oil can, believing that this will take care of the chain lubrication, whereas the oil does not get to the rollers and bushings where lubrication is needed. The only way to lubricate chains properly is to remove them from the machine, clean them thoroughly by placing them in an old clean pan or a suitable receptacle, and cover the chains with plenty of kerosene or gasoline. Do not be satisfied with letting the chains soak a while, but move them around and stir them up, so that all of the grit is removed from between the rollers and bushings. After the chains are thoroughly cleaned in this manner the proper chain lubricant should be applied. After taking the chains out of the lubricant, hang them up to dry, allowing the extra lubricant to drip into the utensil used for heating the paste. This lubricant is a paste formed of grease and graphite, so prepared that it can be reduced to a liquid state by heating. When so reduced the chains are immersed in it.

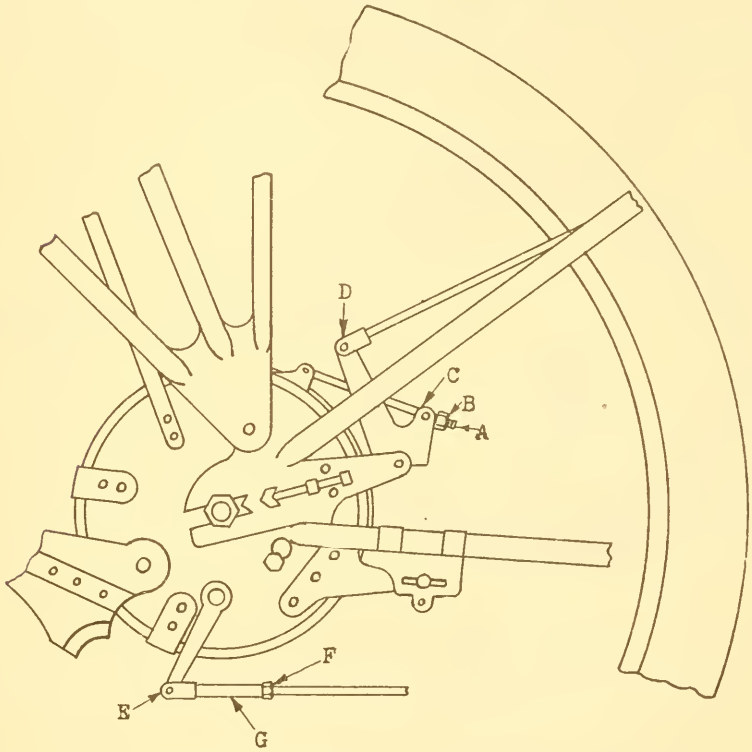
Use this chain lubricant in all conditions of service. Full instructions are to be found on the label of the container. The chains should be allowed to remain in this material for at least fifteen minutes, so that it thoroughly permeates the chain links and rollers.

In sections where winters are very severe it is good practice to use thin oil, such as light cylinder oil, on the chains during the winter months. The oil should be applied to the chains in the same way as the grease; but the work must be done in a warm room, of course, so that the oil will be thin enough

to work in under the rollers. If necessary, heat the oil. This can be safely done by placing a can of oil inside a can of water and then heating the water.

Chains properly cared for give remarkably good service and do not cause any delay on the road. The best plan to pursue is to keep the chains properly adjusted and well lubricated. They should receive the treatment and attention outlined every five hundred miles.

Brakes.—Frequent inspection of brakes should be required. Detailed instruction for the adjustment of both types are given herewith.



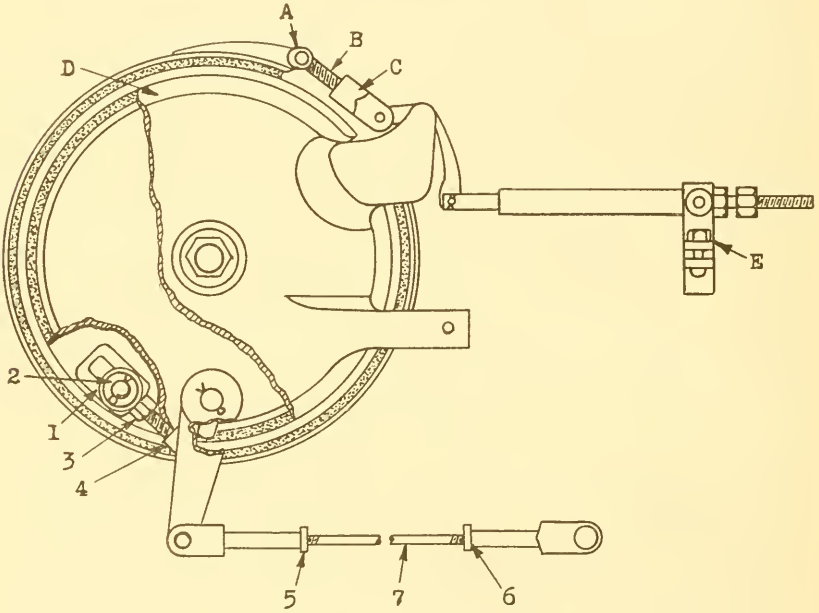
HARLEY DAVIDSON
SKETCH NO.6.

Harley-Davidson Brakes.—If the foot brake does not hold, remove the pin connecting the clevis of the brake rod to the brake arm. Loosen the clevis lock nut and screw the clevis farther on the brake rod until the desired adjustment is made. *Caution:* Do not set the brake too tight. With the machine on the stand and the brake released the wheel must turn as freely as before the brake was adjusted.

Harley-Davidson Hand Brake.—If the hand brake does not hold, as is the case at times owing to the natural wear, and when the position of the rear wheel has been changed to adjust the chain, the proper adjustment can, in most cases, be obtained by merely adjusting the band eye bolt and the clamp. Be-

fore the making of any adjustment it is advisable to remove the long drive chain and to set the machine on the stand. If the brake does not hold properly, loosen a few turns, then tighten the opposite nut. Be careful that the brake is not set tight enough to drag; and to prevent this, turn the wheel after making this adjustment. The wheel must be perfectly free after making the adjustment, and the brake lever must bear against the stop when released. If the lever does not bear against the stop, brake action is lost. In this case readjusting of the frame is necessary.

Indian Brakes.—The external brake is operated by a finger latch on the left handle bar and can be applied by pulling upon this lever. The internal brake is operated by the pedal on the right footboard. To adjust the external brake, proceed as follows:



INDIAN BRAKE
SKETCH NO.7.

Remove cotter pin that retains pin and take it out. Next lift up eye bolt screw from the clevis where it is connected with pin and turn it to the right two turns, screwing it into "C." Now replace eye bolt and eye bolt pin as before and test the brake by running the motor on the stand. If it does not hold satisfactorily, screw eye bolt into the clevis another turn or two. When the brake is released it should not drag or drum. To test for dragging, spin the rear wheel by hand with the gear shift lever in the neutral notch and the clutch engaged. If the rear wheel does not spin freely, see if the external brake band is dragging. If such is the case, loosen the screws on the frame clamp and move the clamp backward toward the rear end of the frame just a little. Test the brake for dragging and continue moving the clamp very grad-

ually until the wheel runs free with the brake released. Then tighten clamp and replace the cotter pin. When the brake is hard on, there should be a clearance of at least 1½ inches between the finger latch and the handle bar grip. If the latch lever comes too close to the grip, the maximum pressure cannot be obtained. The proper clearance for the finger lever may be obtained by moving clamp forward or backward after the brake has been adjusted.

To adjust the internal brake proceed as follows: Remove the cotter pin (1), (Sketch 7), loosen nut (2) by turning to the right, loosen lock nut (3), and turn screw (4) to the right three or four turns. Now test the brake with the motor running on the stand. When the brake is on hard, the foot pedal should be at least 1½ inches from the foot board. After the proper brake adjustment is obtained, tighten nuts (2) and (3) and replace cotter pin (1). If the foot pedal comes too close to the foot board or touches it, full braking power cannot be obtained. Neither should the pedal come too high when released. Proper position can be obtained by loosening lock nuts (5) and (6) on either end of the long brake rod (7) and by turning this rod. Turning it to the right raises the foot pedal; turning to the left lowers the foot pedal. Be sure that the lock nuts are retightened after adjusting brake rod.

After adjusting the chains always make a test to see that the brakes are in good condition. They may need readjusting by reason of the shifting of the rear wheel. Watch the brake linings. When they become worn, have the machine sent to the mechanic for their replacement. *Keep oil away from the brake lining.*

Keep all brake nuts tight and be sure all cotter pins are in place. Put a few drops of oil on all working parts every day. If the brake linkage is kept well oiled and free working, the brakes always release quickly and there is no mysterious loss of power through dragging.

Equipment.—Speedometer should be inspected daily to be sure that all fastening bolts are absolutely tight. The fiber gear wheel at the end of the speedometer drive shaft should mesh properly with the metal driving gear on the rear wheel. This is especially true after the chains have been adjusted. There is no excuse for these fiber wheels being injured. Given proper care and attention they last indefinitely.

The lighting system also requires daily inspection and care. The tubing should be looked over to see that it is all in place and tight. Gas tanks should be inspected to be sure that they contain enough illuminating gas for the night's use.

When the lamps are lighted they should not be turned up too high. This is an inexcusable occurrence and results in burned lamps, broken reflectors and front door glasses. Always burn a full flame at the jet. Never turn the gas pressure down so that a small flame appears at the burner. This practice causes the jet to clog up with carbon on one side and causes a lop-sided flame the next time the burner is lighted.

The tools furnished with every machine by the manufacturer should also be well cared for. Weekly inspection should ascertain whether each driver has a full kit. If any tools are missing, he should be held individually accountable. If broken in use, they should be turned in for replacement. Every machine should have a full kit of tools before going out on the road. Only the most rigid adherence to this system insures that each motorcycle has its full tool equipment.

All connections of the side car to the motorcycle frame should be inspected daily to see that they are properly fastened. The side car wheel bearings

should be adjusted, cleaned and repacked with grease the same as the rear and front hub bearings. The Harley-Davidson side car is flexibly connected to the motorcycle by ball joint connections. The lock nuts on these connections should be inspected daily to see that they are all tight. The balls should have plenty of movement without any end or lateral play. Oil should be inserted daily into the ball joint and the socket to insure proper operation of the joint. This side car is connected in this way to relieve the motorcycle frame from lateral vibration. Never allow the ball joints to be tightened until the car is rigid.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

THEORETICAL AUTO ENGINEERING

LECTURE X

Principles of Manufacturing Pneumatic Tires

A pneumatic tire consists of (1) an air chamber, and (2) an envelope or covering. For the purpose of familiarizing the two parts, we will hereafter refer to the air chamber as the "tube" and the envelope as the "case."

Pure rubber will not vulcanize at any known temperature, and it is therefore necessary to mix it with vulcanizing agents before it can be used as a manufacturing product.

The tube is composed of ninety-five per cent pure rubber, and five per cent sulphur or other vulcanizing ingredient. The compound is first rolled into sheets of about 1/64 inch thickness. It is then cut the desired size and wound on a mandrel of correct dimensions. As it is wound it is also rolled with a concave roller which presses the plies together and makes of the sheet of rubber a seamless tube. The next operation is to wrap it with wet strips of cloth and vulcanize it. When cured, it is removed from the mandrel and the ends spliced together, the valve and valve pad attached, and the tube is ready for service.

The case is composed of clinchers or beads, several plies of rubberized cotton fabric, covered by a rubber cushion, and a wearing surface known as the tread. The bead of the case is that part which fits on the rim of the wheel, and holds the case in position thereon. It is composed of fabric in clincher type cases, and of hard rubber compound, or fibre, reinforced with wires, in the quick detachable type. The former are made to stretch over a one piece rim, and the latter are constructed so that they cannot stretch, and must slide over a two or three piece rim, or to be used only on a quick detachable rim, a split rim, or a divided rim. The Q. D. case is considered the better type, as it has a tendency to stay *put*, when inflated, and is changed more readily.

The fabric is constructed in such a manner that it encloses the beads and is of great strength, each ply having a tensile strength of about 400 lbs. to the square inch.

Pure rubber is a vegetable matter, and will not stand friction nor road traction in its natural state. In order to use it as the wearing surface of the case, it is first necessary to mineralize it by mixing it with certain compounds such as lead, zinc, whiting, ocher, sulphur, etc. Such a process makes of it the best material available for use as the tread of an automobile case, and it usually outlasts the body fabric.

The purpose of the tube is to hold sufficient air pressure to bear the weight of the vehicle, and to furnish a cushion between the wheels and the road, thus eliminating or reducing the shock caused by passing over the uneven surface of the ground. The case is used as a protection and a wearing surface for the tube. If a rupture occurs in the case, it necessarily follows that the air pressure contained in the tube will blow out, resulting in a flat tire.

The principle of the fabric and the cord tire is the same, although the construction is somewhat different. The cotton used in the fabric case is closely woven and has but a thin veneer of rubber solution between the plies. The

cord tire is built of walls of stout cord, each cord embedded in almost pure gum, no two cords ever touching to cause friction. The cushion (which is under the tread to absorb shocks) is a thick layer of high grade gum. The beads which hold the case to the rim are especially reinforced. The side wall is also reinforced, giving extra strength against rimcut, and raising the bending point safely high. On some cord tires the cords are secured at the beads with hooks, while in others the cords encircle the beads. The cord tire is much more resilient than the ordinary fabric tire, and has longer life. It stands the road shocks better, and when cuts occur they do not seem to cause as much damage as in the fabric case.

Everyday Care of Pneumatic Tires

If tires received the same careful attention as the other units of an automobile, they would give much better service. It seems to be the common practice to watch carefully all other parts of a vehicle, and never look at the tires until they puncture or blow out. In these days of high cost and curtailed production, it is very necessary that tires receive proper care and attention.

Before starting on a trip all tires should be inspected to see if they are properly inflated, or if they have received cuts or bruises which have weakened them to the extent that they are liable to blow out before the trip is ended. If there are cuts which penetrate to the fabric, these should be plugged with rubber putty, or vulcanized at the first opportunity. Otherwise moisture will seep through the cut, loosening the rubber and decaying the fabric.

Overloading the tires has the same detrimental effect as under inflation. The side walls of the tire are bulged at the contacting point with the road, and the different plies of fabric chafe against each other until the rubber between the plies is destroyed, and a blow out is liable to occur. The chafing of the fabric works on the same principle as that of rapidly bending a wire to and fro until it breaks. The tread rubber also separates from the fabric if the tire is overloaded or under inflated.

The car should always be stopped as easily and smoothly as possible. Putting the power on suddenly throws all the weight and power directly on the rear tires, and subjects them to terrific strain, besides the fact that it also does harm to the car in general.

A careful chauffeur will always throw out the clutch, and coast around a sharp corner or turn. Never drive rapidly right up to the stopping point, and then slap on the brakes and slide into place. Always figure out your distance, throw out your clutch and coast to a stop. It is then seldom necessary to apply the brakes. If extreme care is not taken in this regard, the rear tires on a machine will be ruined in a very short time. The effect is the same as placing the case against an emery wheel, and grinding away sections of the rubber. It also weakens the fabric.

Check up the alignment of the wheels occasionally, as tires used on wheels which are not running true will wear through within a few hundred miles.

Keep oils and grease away from the tires at all times. Whenever either is allowed to come in contact with the rubber, it becomes softened and deteriorates rapidly—thereby shortening the life of the case. The rubber of the tube is affected more by the action of grease or oil than that of the case, and soon becomes useless. Care should be taken to keep the proper oil level in the differential housing, for if too much oil is used it will leak out through the end of the axle housing and all over the tire case.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

LABORATORY

EXERCISE XI

WRITTEN LESSON

This exercise is to be a written lesson on all preceding work.

MOTOR TRANSPORT CORPS

EXECUTIVE DIVISION—TRAINING BRANCH

Motor Cycle Drivers' Course

MILITARY INSTRUCTION

The material covered by the following references will be given by brief lectures on the drill field, in the barracks on rainy days, in evenings, or at such other times and places as the instructor shall feel advisable and necessary. It is not felt to be necessary to group these references to cover special hours of the course, as the amount to be covered, as well as the proper time in the course when it should be taught, must be left to the judgment of the instructor.

References:

1. Manual for Non-Commissioned Officers and Privates of Infantry, Paragraph 48 to 73, inclusive.—School of the Soldier.
   Men should memorize "Position of the Soldier."
2. Manual for Non-Commissioned Officers and Privates of Infantry, pages 9 to 18, inclusive.
   Instructor should give a talk on Military Discipline and Courtesy.
3. Manual for Non-Commissioned Officers and Privates of Infantry, paragraphs 71 and 72.
   Soldiers should memorize marching to the rear and marching by the flank.
4. Manual for Non-Commissioned Officers and Privates of Infantry, paragraphs 77 to 94, and 98 to 100.
5. Small Arms Firing Manual.
   Chapters 1 and 2.
   Position, Aiming and Trigger Squeeze Exercises.
6. Manual for Non-Commissioned Officers and Privates of Infantry, paragraphs 98 to 100, page 74.
   Paragraph 745, page 111, first section.
7. Manual for Non-Commissioned Officers and Privates of Infantry, paragraphs 101 to 122, inclusive.
   Men should memorize Squad Right and Squad Right About.
8. Articles of War:
   Articles 1, 2, 29, 54 to 96, inclusive, and 104 to 109, inclusive, shall be read and explained.
9. Rules of Land Warfare.
   Chapter 4, paragraphs 45, 46, 49 to 53, inclusive, and 57 to 60, inclusive.

NOTE.—In all cases where it is necessary for the men to memorize any positions or marches, etc., mimeographed sheets of the material shall be supplied to them.

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